MARCH 1951

THE SCIENCE TEACHER

- Books and the Teaching and Learning of Science
- Evaluating Elementary Science Instruction
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JOURNAL OF THE NATIONAL SCIENCE TEACHERS ASSOCIATION

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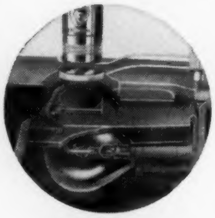

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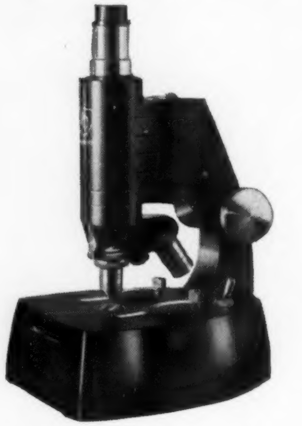

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THIS MONTH'S COVER. Books for the teaching and learning of science had a prominent place in the booths of over 35 publishing companies participating in the Atlantic City exhibit, February 17-22. The exhibit—the largest, most complete showing of school equipment, classroom tools, and teaching aids in the world—is a regular feature of the annual convention of the American Association of School Administrators. Occupying 90,000 square feet of floor space in the arena of the Atlantic City Auditorium, the exhibit brought together displays of more than 300 firms whose materials were classified into about 100 different categories.

In addition to those pictured on the cover, publishers who regularly advertise in the Journal and who had booths at the exhibit include: American Book Company, Harcourt, Brace and Company, Inc., Iroquois Publishing Company, Inc., The McGraw-Hill Book Company, Rand McNally & Company, Charles Scribners' Sons, Silver Burdett Company, and D. Van Nostrand Company, Inc.

Advertisers in other fields who were represented at the exhibit are: American Optical Company, Bausch & Lomb Optical Company, Better Light Better Sight Bureau, Denoyer-Geppert Company, The Jam Handy Organization, The Judy Company, Keystone View Company, "Science Kit," Welch Manufacturing Company, and Young America Films, Inc.

Photo: Fred Hess & Son; Compliments of the Companies Pictured

Guided Missives

ARROWS ON THE EYES. Carlos Sierra Franco, the artist responsible for the new headings on standing columns that appear in this month's issue of the journal, is from Guatemala. He tells us that in his country when they want to "come right to the point" or "lay the cards face up on the table" the expression used is, "Let's put the dots on the eyes."

Editor, *The Science Teacher:*

I was interested and pleased with the article, "A Plea for Inductive Teaching," in the December issue of *The Science Teacher;* also with the previous article, "Individualized Laboratory Work Must be Retained," by the same author.

But mainly I want to comment on Mr. Lefler's article, "Archimedes' Principle," in the December issue. This is my response, in a negative form, to your request for more "discovery-type" laboratory problems.

According to definition the experiment with the mythical crown is an illustration of the deductive method, yet the author calls it a "discovery-type" experiment. I am wondering just what the student would discover in that experiment. Certainly not Archimedes' principle. According to the article the experiment is to "grow naturally out of class discussion on Archimedes' principle." The class, then, has previously discovered the principle in a textbook assignment.

To give the problem to students who have never heard of Archimedes' principle would certainly be a waste of time. But if such students were instructed (cookbook) to determine the weight of an object in air and in water and also the weight of the displaced water, they would *discover* the relation between the loss in weight and the weight of an equal volume of water. I would prefer to call this a "discovery-type" experiment.

It would be interesting to learn what laboratory procedure the author would use for his paraffin crown experiment. Would he have enough crowns so that each student could do his own work and his own thinking, or would it be a class project where two or three students do the work and the others are entertained? Or would it be the rotary method where the appartus for several experiments is put out and the students rotate in their work obtaining in a short time the results and the "procedure" (cookbook) from each other?

It might be interesting to your readers if there were a department in *The Science Teacher* for com-

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ments and criticisms of articles published in the magazine.

H. Clyde Krenerick
Milwaukee, Wisconsin

Editor's Note: This column provides an outlet for comments, criticisms, and suggestions of all kinds. We understood Mr. Lefler's article to mean that only a few students, perhaps one or two in a class, would do the crown experiment; and that they would do it as a "problem" whose answer could be found only by experiment and by the *use and application* of Archimedes' principle.

National Science Teachers Association:

Enclosed are membership applications from 18 graduate students at San Jose State College. This brings NSTA membership to 100 per cent for our current classes in science education.

As part of their class work, these students are gathering and filing as much teaching material as possible. They are extremely interested in the valuable materials included in the Packet Service of NSTA. Can you help us procure back issues of the packets or their contents? And I'm making the same request as regards this school year's issues of *The Science Teacher*. The last several issues have been superb. Three articles from the last issue—those on Evaluation and the Plea for Inductive Teaching—are on the recommended reading list for the class, as they fit perfectly into our teaching program.

John P. Harville
San Jose, California

Editor's Note: Thanks for the kind words. Some help is on its way.

THE SCIENCE TEACHER

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The National Science Teachers Association is a Department of the National Education Association and an Affiliate of the American Association for the Advancement of Science. Established in 1895 as the NEA Department of Science Instruction, the Association later became the American Council of Science Teachers. It merged with the American Science Teachers Association and reorganized in 1944 to form the present Association, and **The Science Teacher** became the Official Journal of the new National Science Teachers Association.

Editorial

What Kind of Science Teaching Is America Willing To Buy?

We know pretty well what brand of science teaching America *needs.* But what America seems willing to buy may be another story. Take the case of Mr. X, for example. (This is a true story.)

Mr. X is now 28 years old. He served four years in the Army during World War II. Since his high school days he has wanted to be a teacher—a classroom science teacher. For one year following his Army days he worked with the Weather Bureau at a salary of $3000 per year. But he wanted to be a teacher. So he took two years off and went back to the university, coming out with a master's degree. He majored in chemistry and completed all professional requirements for certification. Now he could begin his chosen professional career.

So he got a job in a Maryland county adjacent to Washington, D. C. By all reports he is a *good* teacher. He does a good job in the classroom. He engages in professional activities, both in a general way and within his own field of science. He takes part in community affairs. He—well, he's a good teacher. And his salary is $2400 per year.

But now Mr. X is faced with a really serious problem. Married and with a youngster four months old, he is having to decide whether he wants to be a teacher badly enough to turn down an offer from a large mid-west chemical concern. The offer reads like this: a three-months' training period at a salary of $4200 per year followed by a job in the laboratory at $4800—with opportunities and assurance of advancements. It's tempting. Maybe Mrs. X could give up outside work and be a homemaker once again. Maybe they could afford another baby. But he wants to be a teacher. It's a tough decision to make.

To our way of thinking, the citizens of that Maryland county have a decision to make, too. What kind of teaching do they *want* for *their* children? And what kind are they willing to *pay* for? Lots of other places in America face the same problem. Meanwhile, Mr. X's all over the country are also making decisions.

BOOKS *and* THE TEACHING AND LEARNING *of Science*

FEW elements in the school situation are taken more for granted than books. Along with pupils, teachers, and buildings, books have traditionally been considered as essential in nearly all subjects in our school and college curricula. In many instances the textbook *is* the course. The laboratory manual "to accompany the text" in science courses has, in recent years, evolved into the so-called workbook or activity book. Then there are the library and classroom reference books which we frequently suggest or even assign to pupils for "enrichment" purposes—for broader and deeper reading.

How effectively do we select and use books in the teaching and learning of science? Are there aspects of this question in relation to which our practices might be improved? With such questions as these in mind, we have brought together six different "viewpoints on books."

About the contributors themselves: Hanor A. Webb has "lived and breathed" science teaching for more than 40 years as teacher, author, editor, consultant, and in other capacities. Through his teaching in college courses, and in workshops and institutes, he has directly influenced the thought and action patterns of thousands of science teachers. His "Chats With Science Teachers" appear frequently in *The Science Teacher* and have now reached ten in number.

William S. Rumbough, as he confesses in his article, was "an Army man" for 30 years following World War I. However, judging by seeing him in action in his "science methods" course at George Washington University, his Army experience did not lessen his knack at good teaching. In 1949, after three years of teaching science in the Falls Church High School, he became its principal.

Louis F. Vogel is another former science teacher who has "strayed" from the classroom—but not too far. His present work as a science textbook editor requires that he keep close tab on the pulse of science teaching today. Mr. Vogel has taught science in Rivers County Day School, Chestnut Hills, Massachusetts, and in Browne and Nichols School, Cambridge.

Francis St. Laurence teaches biology in the Technical School of the Bristol High Schools. He spent three years with the USAAF in The China-Burma-India theater, and he has taught in the USAFI program. His contribution to this symposium is based on a research study which he did as part of his work for the Ed.D. at Teachers College, Columbia University.

Jack Hudspeth has had many years' experience as a classroom teacher of science at both elementary and secondary levels. In recent years his responsibilities have been in an editorial capacity with the prime duty of developing science offerings for his company. He also has authored or co-authored numerous science books. In 1941–42 he was president of the NEA Department of Science Instruction, the forerunner of NSTA.

Herbert S. Zim has devoted himself chiefly to writing about, and teaching, science for young pupils in the elementary grades and junior high school. His books and magazine articles are numerous, and they enjoy well-deserved, wide circulation. Prior to moving to the University of Illinois he taught science in the Ethical Culture Schools, New York City.

James Harold Fox, the summarizer of this series of articles, is also a former science teacher. Holder of degrees from Harvard University and the University of Western Ontario, he has done biological research work with the National Research Council of Canada. Dr. Fox has two children—a young son, and a daughter who plans to enter science teaching next fall.

The High School Science Library

By HANOR A. WEBB

Professor of Science Education and Chemistry
George Peabody College for Teachers
Nashville, Tennessee

Every year some 200 new books appear in the field of science on the high school level. Each title is worthy of consideration as to purchase for the high school science library. If the science teacher could order every one of them, the bill would be between $400 and $500! Of course, you may dream about this liberal book budget.

Perhaps only one library in our nation receives all of these books—the Library of Congress in Washington, where copyrighted works are deposited. The annual order of books for the high school science library, therefore, becomes a problem of selection. An ideal situation exists when the librarian has a high interest in science and the teacher is a true lover of good literature.

Selection becomes simpler if certain ideas guide the choices. This is true whether the budget for the year be $10 or $100. (We hesitate to offer our proposals for a "dream budget" of $1000 or more.) What are the characteristics of those books to be listed for early purchase?

1. *The books selected should be new.* Old books may interest the collectors of antiques, but not youth. Could the presence on the shelf of *Knights of the Air* by Molter (Appleton, 1918), or *An Hour of Aviation* by Macmillan (Lippincott, 1930), or even *American Wings* by Leyson (Dutton, 1940) make unnecessary the purchase of *Young People's Book of Jet Propulsion* by Ross (Lothrop, 1950)?

Is a decade of progress in electronics to be ignored by omitting *Television Works Like This* by Bendick (McGraw-Hill, 1949)? Does the popular understanding of drugs and diseases need no refreshing as to the sulfas, penicillin, streptomycin, and other "wonder medicines"?

Even the so-called "static aspects of nature" are touched by man's progressive understanding. New books may be ordered about birds, as *Introduction to Birds* by Kieran (Garden City, 1950); about flowers, as *A Guide to Familiar American Wild Flowers* by Zim and Martin (Simon and Schuster, 1950); about nature in general, as *Field Book of Nature Activities* by Hillcourt (Putnam, 1949). The knowledge of insects, gardening, weather, the soil, should be kept up-to-date. We may be sure that as long as books on nature continue to be written their observant authors are finding something new and interesting.

For certain highly significant areas of science the only books about them that exist are new. Such a title is *Young People's Book of Atomic Energy* by Potter (Dodd, 1948). Others on television, jet engines, and the like are listed elsewhere in this discussion.

The high school library is no mere storage space. If it is to be used freely and willingly by students, it must offer them the latest knowledge in all areas of their important interests.

2. *The books selected should be diversified.* Librarians and teachers should have an airplane view of science. The distant perspective should cause the single, fenced fields of science to dwindle in apparent size and importance, while the whole spreads out as a boundless vista. Of such a breadth is science. Therefore, no matter how small or how large the purchase order may be, the titles should be picked from as wide a variety of scientific areas as possible.

Even strong local interests do not justify a seriously unbalanced list. High School students are not specialists; they will not all remain in the home community. They should have contact with all phases of nature and human activities that are based on science.

In addition to the obvious selections of books treating of astronomy, biology, chemistry, physics, weather, and similar organized fields, the order for the high school library should include such areas and representative titles as these: exploration—*High Jungle* by Beebe (Duell, 1949); pets —*Your Dog and Mine* by Lowry (Meredith,

1948); homes—*Your Home, Its Upkeep and Rejuvenation* by Hawkins (Garden City, 1949); hobbies—*Your Camera* by Emanuel (Focal, 1948); stories—*Young Readers' Animal Stories* by Thomas (Lantern, 1950); sports—*Champion's Book of Sports* by Oshins (Garden City, 1949); *Ancient Man in North America* by Wormington (Denver Museum of Natural History, 1949).

Give consideration to borderline books that seem to present science incidentally. You may be surprised how many principles they explain.

Science fiction? It is best to examine these before ordering. Some such volumes have been written by literary masters (Verne, Wells), but others are lurid in style and false in regard to principles. No great need for these highly imaginative books exists, for in science "truth is always strange, stranger than fiction" (Lord Byron).

3. *The books selected should have a wide range of reading level.* Send an average science student to the library without a specific assignment. If he chooses to read science *for interest,* he may select a title from the "youth" catagory (grades six to eight) and enjoy its simple text and liberal illustration. Examples: *Frogs and Toads* by Zim (Morrow, 1950) or *Owls* by Zim (Morrow, 1950). But if this average high school student reads *for information* on a subject that concerns him seriously, he may find a well-written, college-level book to his liking. Examples: *Partners With Nature* by Green (International Textbook, 1950) and *Minerals and the Microscope* by Smith (Macmillan, 1949).

It is obvious that the lower-level books will accommodate the poorer readers in a science class, while the higher-level books challenge the better readers. By such diversity the ever-present problem of individual differences is at least partly met.

4. *The books selected should meet instincts of high school youth.* What are these chief instincts?

THE HERO-WORSHIP INSTINCT is well served by the biographies of scientists and inventors. Certain life stories seem never to grow old. Numerous indeed are the volumes on the life of Edison; the latest is *Thomas Alva Edison* by Clark (Aladdin, 1950). The lapse of a century has not caused the memory of Darwin to fade; the evidence is *Charles Darwin* by Sears (Scribner's, 1950). The collected lives of chemists has been brought up to date in *Crucibles: The Story of Chemistry from Ancient Alchemy to Nuclear Fission* by Jaffe (Simon and Schuster, 1948). The first issue of *Crucibles* was in 1930.

Who are the heroes of science today? We must await the judgement of authors who write a few decades hence, for whom the perspective of time has separated the truly heroic from the merely spectacular. If you are a young science teacher, why not make a list of heroes and check it 40 years from now.

THE HEROIC OCCUPATIONS INSTINCT is met each year by appropriate titles. Recent examples: (aviators) *Visibility Unlimited* by Grace (Longmans, 1950); *Big Game Hunting and Marksmanship* by Lee (Small Arms, 1950); *Of Men and Mountains* by Douglas (Harper, 1950).

THE ADVENTURE INSTINCT is fed by the vicarious experiences of adventurous authors. Descriptions of Antarctic intrepedity have been brought close to the present by *Strong Men South* by Menster (Bruce, 1949) and *Snow, Ice and Penguins* by Lee (Dodd, 1950). A balsa raft bearing six men floated westward from Peru across the Pacific, its story told in *Kon-Tiki Expedition* by Heyerdahl (G. Allen & Unwin, London, 1950). Other sagas are in recent print.

THE DOMESTIC INSTINCT is responsible for the popularity of titles dealing with homes and hobbies. Just name your activity; there's a book for it! Is it cooking? Select *Basic Guide to Good Cooking* by Wrightnour (Grossett, 1950). Is it sewing? Include *Standard Book of Sewing* by Lowrie (Garden City, 1949). Is it gardening? List *Every-day In My Garden* by Farthing (Macmillan, 1950). Is it a workshop? Try *Working with Tools for Fun and Profit* by Collins (Garden City, 1949). Is it pocket money? Get *75 Ways for Boys To Make Money* by Paradis (Greenberg, 1950) and *Every Woman's Guide to Spare Time Income* by Lehman and Yarmon (Harcourt, 1950).

Were this list of youthful instincts lengthened, it would include the gang instinct for which Boy Scout and Girl Scout manuals offer guidance; the collecting instinct for which titles appear frequently; the curiosity instinct which is behind experimentation, and several others. The adolescent is indeed a bundle of instincts—"some baser, some nobler, all necessary" (Newman).

5. *Some science books should be selected for vocational guidance.* The high school is a Temple of Decision in which a life of self-support is planned for almost every student. Many specific inquiries about scientific occupations should be well answered in the high school library. The value of such titles as these will be obvious: *Making Inventions Pay* by Keeley (McGraw-Hill, 1950);

Your Career in the Metallurgical Profession by Sullivan (American Society for Metals, 1948); *Aviation from the Ground Up* by Floherty (Lippincott, 1950). The newer technical vocations should have special attention, as with *Training the Local Announcer* by Gould and Drummond (Longmans, 1950) and *Your Opportunities in Television* by Harrington (McBride, 1949).

Less glamorous occupations should not be ignored; a period of a few years brings titles that describe almost any type of labor that offers employment to fair numbers of workers. For those students plagued by indecision there may be help in *The Right Career for You* by Benge (Funk, 1950). We hesitate to mention another title for which there might be much demand; it is *How To Avoid Work* by Reilly (Harper, 1949).

6. *Certain reference books in science should be selected.* Although their contents are primarily factual, and unchangeable, there is still a problem of up-to-date-ness as to recent data and elimination of obsolete information. A new reference volume is a comforting possession, an excellent example being *Fieldbook of Natural History* by Palmer (McGraw-Hill, 1949).

7. *On occasion a science book should be selected for its literary style.* Is this a paradoxical idea? A few scientists are also literary craftsmen of the highest skill. Certain naturalists can match any poet in the expression of noble thought. You may test this in *Cup of the Sky* by Peattie and his son (Houghton, 1950) or *Arctic Venture* by Gilbert (Holt, 1950).

8. *Are there "bad" science books to be avoided?* Fortunately, not many. Editors readily detect the crackpot manuscripts and reject them. Few science books on the high school level are outrageously dull, for editors and authors know the need to interest their readers. You would not knowingly select an inaccurate science book, yet you must make allowance for the level of writing. To keep his story simple, an author may tell the truth, but not the whole truth.

Occasionally a book unsupported by scientific fact does appear. In 1920 Marshall B. Gardner issued *A Journey to the Earth's Interior, or Have the Poles Been Discovered?* His theory was that another sun is exactly in the center of the earth, shining upon interior, and inhabited continents. His colored plates were wonderful, showing the sunlight streaming through the polar openings, causing the aurora borealis. He quoted noted astronomers and geologists whose writings—as he interpreted them—confirmed his beliefs.

A similar book appeared in 1950, written by Immanuel Velikovsky, entitled *Worlds in Collision*. It concerned an erratic comet that appeared whenever any great event on our planet needed an explosive force. The Children of Israel, for example, ate its tail (which they called "manna") as they wandered in the Wilderness of Sin. A few centuries ago the comet accepted the law of gravity and became the sedate planet Venus.

Gardner was forced to publish his book himself, and it probably did not have a wide sale. But a current publisher risked the firm's excellent reputation in behalf of the great profits Velikovsky's sensation would bring after an amazing publicity program. Men of science, who tolerate crank books because they make little impression on intelligent people, objected strenuously to the advertising of *Worlds in Collision* as a revelation of newly-discovered scientific knowledge, discrediting every presently-accepted principle of astronomy, mathematics, and geology. Some teachers of high school science already report challenges by students, based on Velikovsky's theories.

There are plenty of books, therefore, for the high school science library. Is there plenty of money to buy them? Here, indeed, is a problem for another discussion.

Another New Booklet by NSTA . . .

. . . Has just come off press. Titled *Safe Use of Electrical Equipment,* the booklet is informational for teachers and students and includes suggestions for teaching and a quiz sheet for pupils. It was prepared jointly by NSTA and the National Commission on Safety Education. Recommended for general science and physics classes and for laymen.

Regular price of the booklet is 50 cents a copy. However, it will be sent free to all sustaining members of NSTA and is available to other members at only 25 cents a copy. Please send remittance with order; do not send stamps. Order from NSTA headquarters.

Fire Triangle Poster Kit

A kit of materials offering suggestions for teaching fire safety is now available from the National Education Association. Designed for upper elementary grades and junior high school, the kit includes "The Fire Triangle," a poster for bulletin board use, together with a teacher's supplement and 40 copies of a quiz for pupils. Price for the complete kit is 25 cents.

USE the Illustrations!

By WILLIAM S. RUMBOUGH

Principal, Falls Church High School
Falls Church, Virginia

PROBABLY FEW READERS of this issue of *The Science Teacher* have ever examined a high school science textbook of 50 years ago. The present writer studied botany, physiology, and physics in 1908 and 1909. High school science was then experiencing the expansion and the high hopes envisioned by the Committee of Ten. New courses in science were springing up. Teachers were taking charge who had never taught science before. There was little background of experience in secondary school science. High school texts were written by college professors. They were simplified editions of college texts with the more difficult concepts eliminated. Illustrations were sparse and of poor quality. The writer was blessed with a gifted and enthusiastic teacher, and he thoroughly enjoyed science. But students of that day received little motivation from textbooks; they were heavy going.

The First World War claimed the writer, and he stayed on in the Army for 30 years, returning to high school teaching in 1946 like a Rip Van Winkle. There were many changes for the better, but the thing which has been most fascinating is the present-day textbook. They are interesting; they are a happy contrast to the books of the early years of the century; they are full of pictures and diagrams; they are attractive! But students have changed too; many of them are not thirsty for knowledge. Better teaching is needed now, more than ever before, and this in spite of the greatly improved teaching materials.

How may the teacher get full value from the excellent illustrations found in our current texts? Three methods will occur to the alert teacher. The first requires his minimum effort. This is the case when the author has carefully, fully, and interestingly discussed his pictures or charts or figures. The students who study the lesson will, themselves, and without special guidance, gain full value. With such a book the teacher, in making his assignment for a day or for a unit, may merely refer to the illustrations. He mentions their excellence with such appreciation as to arouse the interest of the class and cause the students to look forward to their period of study and to pay special attention to the figures.

The second method is useful when the author has not been so skillful, when illustrations are not fully explained, or when interesting points are not obvious to the rapid reader. This, I think, is the more usual situation. We teachers should realize that many of our students are causal in their study habits. The biology lesson competes with the deep-throated strains of Vaughn Monroe or with the exciting stars of "Toast of the Town." There is little time between these radio or television "musts." Perhaps "Conservation of Living Things" is the evening's lesson, but it has to be satisfied with one half hour which can be spared from alluring audio-visual treats.

A few weeks ago a television survey utilized the students in two large study halls at Falls Church High School to determine the extent of listening and the program tastes of students in this Virginia suburb of Washington. Approximately 75 per cent of the members of these study halls were frequent or habitual television "fans," and inspection of their answers to the questionnaire showed that many of them spent almost their entire evenings in front of the screen. Television is indeed changing the home study habits of the nation's children. No doubt it is educational and broadening even when the "kids" themselves select their programs. However, a survey such as this indicates that we must motivate and guide our students' study habits as never before. Home study is no longer automatic even for our better students. We need to give our assignments in such a way as to arouse anticipation. We need to point out the value to be derived from a mastery of the subject. And we need to discover which of our 30 students have studied their lessons and to give them approval and encouragement to continue in this good habit. The picture or diagram is a strong feature for this study assignment motivation. When the caption is brief and when the explanation in the text is difficult to follow, it is worth while for the teacher to amplify and explain, seeking to stir up interest in the assignment.

There is a third method of using illustrations. It takes some time and extra preparation by the teacher, but it is more than worth the effort. Let us suppose that we are in physics and are studying

the diagram of the local-battery telephone. The teacher and every student may have the same diagram, each in his own book, but one finds it difficult to explain to a group just how the currents are set up when one speaks into the transmitter. The explainer is looking at, and talking about, one bit of the circuit while the listeners are looking at various other parts. Discussions on such a basis are confusing or even futile.

This kind of difficulty may be resolved if the teacher can give some extra time in preparation to the reproduction of such figures in class-display size. The writer has a large drawing board with "T" square, a stock of vari-colored heavy paper, 24 x 36 inches in size, and black and red Floquil pens. With these it is a matter of a few minutes to copy a diagram in two colors and in such size as may be fastened on the blackboard frame and be visible to the back row. With such a chart and a pointer everyone may follow the explanation and ask questions to straighten out any obscure point. Once made, such a chart becomes a permanent asset to the teacher and to future classes. It greatly increases the usefulness of the figures in the text, and it makes available to all any desired figure in a supplemental book or magazine.

The writer has frequently found, in reproducing such figures, that the detailed scrutiny which the copying has required has brought to his attention interesting points which had not been apparent from a mere perusal of the figure in the text. This kind of copying is interesting to some students, and, if he desires, the teacher may enlist voluntary help in preparing his figures. When this occurs, he has automatically an expert in the class who can explain the figure in clear detail and whose enthusiasm is almost sure to spread to the class.

We modern teachers are blessed with attractive books. They are full of illustrations. Let us use them to good effect.

A Spot-Check Evaluation Scale For High School Science Textbooks

By LOUIS F. VOGEL
Editor, Science Textbooks
D. C. Heath and Company, Boston

WHEN EDITORS of textbook publishing houses want to evaluate a competitor's text, they generally use a spot-check system. Such a method has the advantages of being brief, specific, and realistic. If the sampling of randomly-chosen pages in the textbook is adequate, a clear picture of the text's educational usefulness is obtained. An evaluation scale based on the concept of sampling cannot be entirely objective, since some items are certain to be subjective in nature. The results of using such a scale, however, are certainly more satisfactory to a teacher than a hit-or-miss leafing through a sample copy.

The following scale is organized around ten general headings: qualifications of the author, organization, content, presentation, accuracy, readability, adaptability, teachings aids, illustrations, and appearance. It would be possible to select 100 headings, but this list represents a sampling of the most important things to look for. Actually, while the scale is interpreted in numerical terms for convenience of the teacher, the items are not intended to be of exact equal value. If a science text should, for example, show up as inaccurate, it should be thrown out without question. Teachers, as well as editors, probably have special topics like photosynthesis or the theory of ionization which they like to check.

This was tried out in a class of 40 students in the teaching of science at Boston University. It was found that it could be completed without difficulty in 30 minutes.

This scale is intended as a guide for evaluating science textbooks at high school level. Each of the five items under the ten general sections is preceded by the figure 2, the number of points it represents. Check the items which you believe apply to the textbook you are examining. Add the points for the items you have checked in each section and record in the place provided. Add the partial scores to get a total score. The highest possible score for a textbook is 100 points.

Textbook ____________________
Author ____________________
Publisher ____________________
Copyright year ____________________
List price ____________________
Score ____________________

I. *Qualifications of Author* (See title page, preface to textbook, and preface to teacher's manual.)
- (2) The author has taught the subject about which he is writing.
- (2) The author holds advanced degrees in related fields.
- (2) The author has received assistance from specialists in preparing his manuscript.
- (2) The author has tried out his material in classroom situations.
- (2) The author's point of view, theory, or philosophy is in harmony with that of my school.

Partial score ________

II. *Organization* (See table of contents, the preface, the section headings through one unit, and the end of one chapter.)
- (2) There is a central theme which correlates the whole textbook.
- (2) The textbook is organized into units which are based on student interest and probability of use in everyday life.
- (2) The organization of topics within units is from the less difficult to the more difficult.
- (2) The organization makes use of topics already taught in my school.
- (2) Questions and/or problems at the ends of chapters are graded explicitly in difficulty.

Partial score ________

III. *Content* (See table of contents, index, and five text pages.)
- (2) The textbook contains all the topics necessary for my course.
- (2) Material from one part of the textbook is cross-referenced with similar material in another part of the book.
- (2) The historical development of science is given some place.
- (2) Topics dealing with the latest advances of science, such as atomic energy, are included.
- (2) The social significance of science is stressed.

Partial score ________

IV. *Presentation of Material* (See any five introductions to chapters or problems.)
- (2) The inductive approach is used wherever possible in introducing a new topic.
- (2) The problem-solving aspect of scientific method is stressed.
- (2) The author's style is informal and interesting.
- (2) Unfamiliar scientific terms are set in italics or boldface.
- (2) Important principles are set in italics or boldface.

Partial score ________

V. *Accuracy* (Select any five topics in the index and look them up in the text.)
- (2) All the items I looked up are on the pages indicated in the index.
- (2) The items I looked up are scientifically correct.
- (2) Teleological expressions are avoided.
- (2) Personification is avoided.
- (2) No ambiguity is apparent.

Partial score ________

VI. *Readability** (See any one text page.)
- (2) The average number of words per sentence is below 21.
- (2) Sixty per cent of the sentences are simple or compound, as opposed to complex.
- (2) There are at least four personal references per 100 words.
- (2) There are not more than 42 affixes per 100 words.
- (2) There is at least one application for each abstract principle.

Partial score ________

*** This section is adapted from formulas by Rudolph Flesch.**

VII. *Adaptability* (See table of contents and any five text pages.)
- (2) The textbook is satisfactory for slow, average, and brilliant students.
- (2) Students with rural and city background will find the text useful.
- (2) The textbook is arranged so that certain sections can readily be omitted.
- (2) The authors treat controversial subjects impartially.
- (2) In general the text fits my particular community needs.

Partial score ________

VIII. *Teaching Aids* (See end of chapters, appendix, and teacher's manual.)
- (2) Summaries, questions, and problems at the ends of chapters are adequate.
- (2) References for teachers and students are annotated.
- (2) Appendix material is pertinent and useful.
- (2) The teacher's manual is more than an answer book.
- (2) An annotated up-to-date film list is provided.

Partial score ________

(*Continued on following page.*)

IX. *Illustrations* (See any ten illustrations.)
- (2) The illustrations are relatively modern.
- (2) The photographic reproductions are large and clear.
- (2) The line cuts are well drawn and adequately labeled.
- (2) The figures are tied into the textual material by direct reference.
- (2) The legends under the illustrations are useful learning devices.

Partial score ———

X. *Appearance* (See cover and leaf through the text.)
- (2) The appearance of the cover is attractive.
- (2) The size and shape of the textbook would not be a handicap to students.
- (2) The placement of the illustrations is pleasing.
- (2) The design of most pages is open, rather than crowded.
- (2) The size of type makes for easy reading.

Partial score ———

Are HEAVY Textbooks Necessary?

By FRANCIS ST. LAURENCE
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Bristol, Connecticut

A CLASSROOM TEACHER, chairman of the textbook selection committee in one of the largest high schools in Connecticut, was speaking:

> Here, hold this! We rejected this textbook solely because of its weight without even opening its covers.

Many teachers have observed that high school students carry four, five, or six courses and that the combined weight of their textbooks places an actual physical burden upon young people who are compelled to carry the textbooks home for study. It may be pointed out that the average science textbook increased from 200–300 pages to approximately 600–700 pages (a few have gone over the 1000-page mark) during the past few decades.

There are several reasons for the mushroom growth of textbooks. Strangely enough, one of the earliest, and probably the most important, of the contributing factors was the attention and study given to textbooks by leading educators. In a professional effort to improve the education of the nation's youth during the 1920's and 1930's these leaders established so-called *criteria* for "good" textbooks. Such criteria, among other things, included numerous teaching aids designed to assist the teacher in his educative role.

A second reason apparently developed from the first. In most high schools, and especially the larger, textbook selection committees have been formed for the purpose of selecting the textbooks to be used. It seems that practically all such committees adopted the criteria set by educational leaders who established arbitrary scorecards for textbook rating purposes. Such action put pressure upon textbook publishers to produce books which would rate high on the scorecards.

So a third major factor contributing to this veritable merry-go-round of increasing textbook size proceeded from the first two and was represented by the reactions of publishers and authors. In an understandable desire to meet competition on textbook rating scorecards, as well as in an effort to assist teachers, the publishers and authors multiplied the types and numbers of teaching aids incorporated in their products. To be sure, some authors have rebelled against this tendency or trend. Apparently, there has been a desire to eliminate some of the traditional teaching aids and other materials which exist in textbooks. However, the trend has generally been the other way, with publishers demanding a larger number and variety of teaching aids and desiring to use as many photographs as possible.

Since the trend toward increased size has been under way for some time, and shows no signs of abatement, it was thought that an evaluation of this movement was long overdue. It was not possible at the time (1949) to investigate all of the factors which have been involved in the increase of book size. It was necessary, for instance, to disregard the additional space required to handle all of

the newer knowledge gained as scientific frontiers are pushed forward. Also disregarded was consideration of subject-matter overlapping which exists in the general science, physics, chemistry, and biology textbooks. It is this writer's belief that much of the existing repetition is unwarranted. Moreover, many of the older, traditional subject-matter materials should be subjected to scrutiny with a view to drastically reducing or eliminating topics which bear little relation to present needs.

In an attempt to attack one phase of the whole problem, 14 types of teaching aids most commonly provided in biology textbooks were investigated. The decision to limit the study to this area was based upon the fact that the average science textbook producer devotes approximately 20 per cent of his total page allotment to this type of material.

All of the 170 Connecticut biology teachers teaching in 1949 were interviewed personally with regard to their use of textbook teaching aids. The final results of the survey indicated that the vocabulary or glossary was the teaching aid most widely used, 77 per cent of the teachers indicating a "frequent" to "always" use. The corresponding percentages for the remaining teaching aids were as follows: review questions, 63; outlines and/or summaries, 52; tests, 48; guide questions, 47; demonstrations, 45; lists of principles, 44; experiments, 37; reports, 36; references, 30; projects, 29; problems, 23; visual-aid sources, 11; and field trips, 3.

It should be pointed out that non-use of a textbook teaching aid does not imply that the teaching aid *per se* was not employed by the classroom teacher. In fact, during the survey, many biology instructors hastened to remark that they relied upon other means for fulfilling the stated purposes of textbook teaching aids. For instance, in the matter of references, many teachers assigned current newspaper articles or readings in popular magazines, such as *Life, Readers Digest, Popular Science,* and the like. Again, in the matter of projects, some teachers claimed that pupil-initiated projects were employed whenever possible; when the latter were unavailable, the teachers drew upon their own experiences for worth-while activities of this nature. In this manner it was felt that a realistic contribution to the students' education and growth was made in a more dynamic fashion. Thus, it would appear that unless some textbook teaching aids are (1) made more up-to-date, or (2) made to apply more specifically to actual teaching situations and particular types of environment, they might well be omitted from biology textbooks.

That additional investigation of certain textbook factors is warranted at this time is suggested by the fact that the interviewed teachers, in general, did not approve of the books they were using. The investigator frequently was asked to indicate the source of a "good" textbook. The specific data on this teacher reaction were:

Liked textbook in use	14.1%
Disliked textbook in use	60.2%
Non-committal	25.7%

In conclusion it should be emphasized that the study herein discussed included only the biology teachers of one state. No claim is made that the findings are universal in character. It well may be that further studies along the lines indicated might be profitable, either with respect to other materials of biology textbooks, in other subject-matter fields, or in other geographical areas. But, as far as the existing evidence goes, it seems that remedial action on the part of all concerned should be considered. This might well begin with the classroom teacher taking an active part. For instance, such individuals might prevail upon their supervisors and textbook selection committee representatives to guard against recommending textbooks which contain superfluous materials.

Also, educational leaders might do well to reevaluate their thinking about textbooks in general. For instance, they might test their theories concerning textbook teaching aids in the field before extending advice to publishers. As an example, such leaders have frequently stated that teachers who have little experience, minimum training, and teach in small schools need the teaching aids more than do their more-favored colleagues. These three factors were kept under observation during the study reported here. Analysis of the accumulated data revealed that the factors of teaching experience, teacher training, and school size have little effect upon the use of textbook teaching aids.

Finally, it appears that textbook publishers might make an effort to investigate the possibility of eliminating some of the existing teaching aids and reducing the amount of space devoted to others. But the first move must be made by teachers and educators in general. So long as they agree that teaching aids in textbooks are desirable (whether they use them or not), textbooks are likely to grow in size and increase in cost. Good textbooks, containing only appropriate illustrations and teaching aids likely to be employed by the majority of teachers, and not exceeding 400 pages in length, might be well received.

WORKBOOKS—? YES

By **JACK HUDSPETH**
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Austin, Texas

A SCIENCE COURSE consists in most instances of certain basic knowledge and ideas plus numerous applications to things and events. Usually most of the applications are common throughout the nation; only a few are unique to the locality in which the course is taught.

The teacher wants each pupil to understand and learn the basic knowledge and ideas and become familiar with, and understand, the applications, many of which are part of the pupils' daily living. The teacher also wants each pupil to develop certain attitudes and form certain habits of thinking and acting and also learn to work in a group. A workbook can be of great assistance to a teacher in attaining these goals.

Some teachers say that they are opposed to using workbooks in science instruction, yet they devote much class time to writing exercises and other workbook materials on the blackboard for their pupils to copy and use. Sometimes they have the workbook materials mimeographed or hektographed.

A workbook that is published commercially is written by one or several educators who have revealed skill in teaching, in the preparation of science courses of study, and in the preparation of workbook materials—objective exercises, suggested activities, review questions, etc. The preparation of such materials requires not only skill but much time, more time than most teachers have after they teach several classes and participate in other school functions each day. A teacher who does have the skill and the time to prepare workbook-type material for her own use may find that it is not a cog in a multi-grade program of science instruction.

Rarely can the aims of a science course be achieved if each pupil's work consists only of reading and listening plus unguided activities and projects. Some reading and listening are desirable —even essential, considering the extent to which young citizens need training and practice in those skills.

For the aims of a science course to be achieved the pupils must engage in much overt activity, both individually and in groups. To lead to the desired outcomes this individual and group activity must be well planned in advance and then carefully directed during execution. But this is very difficult, almost impossible, for most teachers, each of whom has several classes of young people of varying interests and capacities. By using a well-prepared workbook teachers can provide the necessary pupil activity and have time to guide their execution although pupils are not doing identical work.

A workbook enables a teacher to do a better job with her pupils because it provides numerous exercises involving the basic knowledge and ideas of a science course and motivation and guidance for individual and group activities of a paper-and-pencil nature. Such activities are not only efficient in time consumption and promotion of learning but provide pupils with training in following printed instructions—an activity that is common in adult life and in which a school child should attain skill. The paper-and-pencil activities also enable a pupil to utilize the material he is trying to learn and to form desirable conclusions.

A useful workbook also should contain illustrations with exercises that require the pupil to study the illustrations, thus learning how really to look at an illustration or a diagram rather than merely to glance at them. It should quide pupils to investigate and study unique local applications. Review questions are useful in a workbook, for they enable a pupil to check his accomplishment. One type of workbook contains brief, terse, factual text on the basic knowledge and ideas of the course. The text not only contributes to a pupil's learning but provides practice in reading for information, rather than merely pleasure, a skill which young people need to develop.

NO

—At Least Not for Beginners

By HERBERT S. ZIM

Associate Professor of Education
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SHOULD WORKBOOKS be used in teaching science in the elementary school? Emphatically NO. And this NO requires clarification only to the extent of pointing out that it applies to science as it is taught today and with workbooks as they now exist. The NO is dictated by a concept of elementary science which is widely held. For whatever other aims elementary science has, its fundamental purpose is helping children discover, explore, and understand their world and to find ways of answering questions and solving problems that are appropriate to their age level. In such activities, facts are essential. Their acquisition through observation and experiment, by reading and consulting local authorities is an inherent part of science education. But lacking this guiding direction of a clear, accepted purpose, facts in and of themselves have little significance. What might develop into an exciting science experience degenerates into a routine reading lesson with a premium on guessing the right answer—or at least the answer that the teacher or the book demands.

One can neither condemn nor praise workbooks without considering the present status of elementary science teaching. Practically all of it is done by the classroom teacher (as it should be), but present classroom teachers are ill-prepared for their responsibility. The majority have had no specific training in science education at all. Recalling their struggle with Physics 101 or Botany 116, many look at science teaching with fear and apprehension. Faced by a difficult situation, these teachers need and want help. But a workbook in their hands becomes an opiate rather than a tonic. It offers a pat, easy, and final solution for filling that trying half hour. In the hands of a skilled and experienced teacher the results might be different, but present-day workbooks are as unsafe with the average teacher as a supply of morphine in the hands of a pain-ridden patient.

Do workbooks contribute directly to the aims of science education? Do they stimulate curiosity and activity or do they substitute such busywork as coloring pictures, labeling diagrams, completing sentences, matching words, or using other devices which have dubious value in learning the facts of science and even less in promoting scientific attitudes and methods? Can children use such books as an aid to exploring problems important to the class, or are they led willy-nilly into superficial contact with stereotyped, factual "units"? Might the time devoted to workbook exercises, questions, and tests be better devoted to simple experiments, field trips, observations, and activities that are both satisfying and stimulating?

Each teacher or administrator must answer questions such as these as he puts aside his order blank and thumbs through a sample workbook. The answers will be apparent on page after page. Here in one book is the story of the formation of coal told in 13 disconnected sentences studded with blanks into which 36 assorted words may be dropped. Will this educational obstacle race yield any scientific reward? A book for first grade directs the pupils' attention to a frame of three pictures in which they are expected to distinguish the plant from the animals. I showed this to a seven-year old and got only a sneer in response. This book has the first-grade pupils coloring flowers. They are still coloring them in the third-grade book, but now they can also draw flowers and fit them into vases labeled "annuals," "perennials," and "pretty flowers."

To top off what seems to be a hodge-podge of poorly selected, poorly organized, and pedagogically unsound devices for teaching anything, some workbooks are so carelessly prepared as to be downright discouraging to use. This one is the typical eight-by-11 size. On page 11 type is set clear across the page in fatiguing lines. Turn, and the top of page 12 switches to three jam-packed columns. For variety the bottom of the page jumps to two columns. Page 13 goes into reverse with two columns top and three at the bottom. Page 14 reverses again, and page 15, to break the monotony, has two columns of unequal width wandering in and out of an unlabeled diagram of the solar system with an overall effect that a surrealist might envy.

The present state of affairs in regard to workbooks is not completely on the level just described, and it certainly is not without hope. Some elemen-

tary textbooks have struck a spark if workbooks have not. Perhaps a five- or ten-year moratorium on science workbooks is in order. During that time we might tackle the whole problem of elementary science with the energy it deserves. We will need to improve teacher training, provide in-service programs, provide teachers with expert assistance in the form of consultant help. Then, as one part of that picture, someone may want to develop a device (not a *workbook* with all that the word implies) to help pupils plan experiments, record their data, interpret their findings, and even check their recall of essential facts. Success will come when pupils find it impossible to sit down and fill in pages by reading alone. The information they will need will have to come in large measure from activities, experimentation, and observation. This isn't Utopian. It is a realistic and practical way to satisfy a need that workbooks have utterly failed to meet.

Some Observations

By **JAMES HAROLD FOX**

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For many, reading is one of the most fruitful of all learning experiences. For some, it is far down the list of productive experiences in terms of learning. How much learning results from a particular reading experience depends upon many factors: the ease with which the learner reads, recognition and acceptance of a worthwhile purpose, rewarding satisfactions, among others. A great deal of assigned reading in our schools, done reluctantly for purposes unrelated to desirable learning outcomes, is more than a waste of time, since it generates attitudes that inhibit further learning.

Yet for the person who discovers a book from which he can find out what he wants to know without too many difficulties, reading may be one of the most enriching of all activities. Hanor A. Webb's guides to the selection of books for the high school science library, if applied, would make such discoveries much more probable and help to make libraries the treasure-houses that they ought to be.

If by teaching we mean helping learners to initiate, develop, and evaluate the most fruitful learning experiences, books may be thought of as teaching aids —the most frequently-used of all teaching aids. This is a concept particularly appropriate for the science teacher, lest reading activities come to dominate the science classroom. Books are rich storehouses of information about science. They

permit the learner to extend vicariously his own observations by adding those of others. Their illustrations, by simplifying hard-to-observe phenomena, help him to study things that might otherwise be obscured.

But the attitudes, the skills, the rigorous thinking of a scientist cannot be acquired by just reading books. The student who would reap the full rewards of scientific learning must observe first hand, compare, test, and experiment. To do otherwise is to learn merely *about* science.

Books that leave an impression of complete knowledge, that cause readers to have a feeling of impotence in the midst of the wizards of science, that overemphasize the classical experiments, are not good teaching aids. Scientific investigation should not be a spectator activity. It is a dynamic movement in which all can participate from the very young to the very old. Science texts should make their readers itch to find out things for themselves. They should spark adventurous forays into reality. They serve best as resources to reorient the puzzled searcher and send him off again revitalized for the fray.

Filling in words or coloring drawings are poor substitutes for first-hand observation and experimentation. Workbooks that employ the time of learners in such activities may do more harm than good, for they may leave an entirely erroneous impression of the nature of science. However, workbooks that arm the learner for scientific investigation at his maturity level could be of immeasurable value. Herbert S. Zim has stated the case well.

Of course, a commercial workbook could save the time of a busy teacher, as Jack Hudspeth contends, if it stimulated the learner to engage in really scientific activities. Unfortunately, those with which the writer is familiar do not do so.

Sometimes the illustrations used in science books close the subject even more effectively than the text. Perhaps a good illustration should raise more questions than it answers. As William S. Rumbough points out, illustrations in current texts are much better than in earlier ones; still there is room for improvement. Diagrams might, in addition to showing how things work, point up existing limitations, for these suggest the probable lines of advance in applied science.

Undoubtedly, Louis F. Vogel's *Evaluation Scale for Science Textbooks* is a very useful instrument. The writer finds no item which he thinks ought not to be there. However, might not a text rate high on the scale and still leave the reader a mere spectator of science phenomena? Why not add an item or two that would call attention to treatment of the limitations of scientific knowledge?

That textbook criteria developed more than 20 years ago need to be reexamined, there can be little doubt. Francis St. Laurence has described well some of their distressing effects. But are size and cost the most important? Perhaps the fundamental role of the textbook in science teaching should be thoroughly reviewed.

Evaluating Elementary Science Instruction

By KENNETH H. FREEMAN
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A Chicago Public School Photo
University of Chicago

Science education authorities and other curriculum experts universally recommend a science program for elementary schools. Administration and supervisory leadership in the establishment of such programs is far from universal. There are woeful inadequacies in funds, materials, and trained personnel. Therefore, the resulting programs should be the subject of continuous evaluation so that they may evolve into a developmental sequence of desirable learning experiences.

Evaluation is the appraisal of the effectiveness of educative experiences in attaining predetermined purposes. It involves judgment. A good program of evaluation should consist of at least three general procedures: (1) formulation of a clear statement of purposes in terms of child behavior; (2) collection of evidence to show how and to what extent the purposes are being realized; (3) interpretation of the evidence in the light of purposes to determine needs for modification and further development of the program.

Finding out by experiment: What materials can cut off (shield) magnetism? Ideas to be tested, ways of working, how the results are recorded, even the expression on the pupil's face—all can be used in the process of evaluation.

Don't be misled by the "elementary" in this article's title. Dr. Freeman's arguments make good sense for *all* levels of instruction. His concept of evaluation necessarily involves selection of content and activities and is also concerned with methods. We'd like to "second the motion" in a loud voice.

Formerly director of elementary education in Rochester, Minnesota, Dr. Freeman is co-author of the John C. Winston Co. *Understanding Science* series of elementary textbooks. His family includes his wife, Kay, and their three girls—Ann 9, Jan 7, and Nan 2.

Formulating Purposes. The first procedure is not to be regarded as complete when a verbal statement of professed values is produced by a small committee. Acceptable purposes should be a functional expression derived from a study of the things we actually work and strive for in our classrooms.

A common purpose of elementary science programs is "to help children be more scientific in their attitudes." Translated into a functional expression in child behavior the objective may be like this:

1. To help children withhold decisions until they have evidence from all available sources.
2. To help children learn the technique of finding answers for themselves.

3. To help children learn to challenge sources of information.

4. To help children to be openminded about "truths" and willing to change on the basis of further evidence.

It is necessary for the teacher to develop situations, or identify existing ones, in which these behaviors may be expected to operate. Classroom discussions, demonstrations, experiments, field trips, playground activities, and extra-school activities may each provide situations wherein these behaviors may be observed from time to time.

Modern courses of study have made some progress in presenting material so the teacher sees the need for checking the application of generalizations or principles in varying situations. The course of study and instructional guide, *Science for Nebraska Elementary School Children,*[1] issued by the Nebraska Department of Public Instruction is organized in this way. The following sample from this publication shows how very definite relationship is maintained between the three sections, "Pupil Activities," "Knowledges," and "What Have You Learned?" The last section identifies situations wherein the extent of application of the knowledges may be observed in operative behavior.

Suggested Activities for Gaining Knowledges About the Weather

Grades—Beginner, 1 and 2

Pupil Activities

3. Put a little water into a pan. Set the pan on the table. Look at the water in the pan every day. What happens to the water? Write a chart story like the one shown below, in which you tell what you did and what happened.

Note to teacher: Explain that water goes into the air. We say that it evaporates.

Knowledges

1. When water stands, it gradually disappears into the air. It evaporates.

What Have You Learned?

1. When your mother hangs her clothes on the line, what becomes of the water in them? (Activities 3, 4, 5, and 6)

2. After a shower, water sometimes stands in puddles on the ground and on sidewalks and pavements; soon the water is gone. What happens to the water? (Activities 3, 4, 5, and 6)

Collecting Evidence. The collection of evidence is not limited to formal pencil and paper testing, either commercial or teacher-made. All useful ways of recording actions and responses of pupils in varying situations should be utilized. This step is descriptive, not judgmental.

Evidence of the attainment of purposes may be collected, in part, by observation of the day-to-day activities of the children. For example, Johnny may ask, "Who wrote this? How did he get to be so great? How do we know his answers are the right ones?" Mary says, "We can't be sure with just one experiment. This should be tried under other conditions."

Careful observation that results in an objective descriptive record of behavior has certain advantages. This method has no limitations of age, place, time, or type of problem in its application. It has the added advantage of the pupil being unaware of the process. The artificiality of a formal testing is not introduced.

Reference has been made to the limitations of pencil and paper tests. One should not conclude that there is no place for these tests. It is the teacher's job to use every profitable means of gathering information. Anecdotal records, case study techniques, tests, interviews, inventories, questionnaires, etc., all have a place in the never-ending task of learning more about the child.

Interpretation of Evidence. Interpretation involves a comparison of collected evidence with initial purposes to reveal need for (1) changes in the educational environment which will facilitate the attainment of our purposes, or (2) some modification of our purposes. This is the judgmental phase of evaluation. It is a phase often neglected by teachers. Too many teachers regard the record of performance as the evaluation.

Ideally, pupils, parents, administrators, and teachers must take part in this appraisal. Varying degrees of participation will depend on the closeness of the individual to the situation. Obviously, the pupil, parent, and teacher will be most concerned.

In trying to describe "what evaluation is," it must be emphasized that it is an integral part of teaching. In its best form it is a continuous appraisal of the achievement of desirable pupil growth through educative experiences.

Can Weaknesses Be Avoided?

Many of the weaknesses of evaluative programs are expressed or implied in the preceding development of an adequate concept of effective evaluation.

The first is the failure to appraise science education experiences in terms of pre-determined pur-

[1] Nebraska Department of Public Instruction. *Suggested Activities for the Science Program in the Nebraska Elementary Schools.* Published by the department. Lincoln, Nebraska. 1948.

poses. There is generally no expression of purposes on the part of the school staff. Many times when statements of purposes are made they are general and nebulous. The practical use of such statements is disappointing.

Secondly, there is a tendency to judge the value of elementary science instruction on the relationship of the norm of a commercial standardized test to the average score of the class on this test. There is great variability in the placement of science topics in elementary school programs. There is great variation in the ability of pupils in any class. It seems safe to conclude that this variability precludes the possibility of the norm of a commercial science achievement test providing an adequate frame of reference for evaluating science achievement in a specific local school. This should not be construed as an inherent weakness of standardized tests. It is rather a plea to avoid misapplication and general misuse of a test designed for a narrow, specific purpose.

A third weakness is the failure to individualize evaluation. Virtually everyone agrees that good instruction must be individualized. Likewise, evaluation must be individualized. Education today is expected to make a difference in the lives of individuals. The success or failure of education to achieve this must be determined in view of the needs, interests, and characteristics of a particular individual.

The tendency to consider evaluation synonymous with measurement is a fourth weakness. Measurement is an important part of evaluation for it may be used to provide much objective information basic to judgmental decisions. But to indicate only the quantitative status of a person's achievement fails to reveal anything about the desirability or value of the situation. Measurement creates a potential of evaluation which materializes when this data is appraised in light of instructional purposes.

A final weakness is to dismiss some of the more functional outgrowths of science instruction as too intangible for measurement. This attitude leads to a condition of apathy. Constant efforts should be made to develop techniques for collecting evidence concerning objectives of this type.

Evaluation Is a Process

The process of evaluation begins with "finding out" about the pupil. The teacher must know the pupil's mental ability, achievement status in school subjects, emotional adjustment, experience, background, and all other pertinent information. It has been repeatedly stressed that evaluation of individualized instruction must itself be individualized. The individualizing of evaluation begins with a study of the pupil which results in directional goals or purposes which the pupil can understand and accept as his own. These purposes will become a part of the broader instructional purposes of the particular school.

Parallel to a study of the child the teacher must make a careful appraisal of the environmental setting. What are the possibilities and limitations in the resources of the teacher, school, and community? Programs will vary depending upon relative training of teachers, rural or urban communities, modern or traditional schools. This by no means exhausts the cultural contrasts which may exist and must be considered.

The developmental sequence of learning tasks must have the continuous consideration of the evaluator. The use of undesirable means for short-term temporary gains which may be ultimately harmful to the student cannot be tolerated.

Fundamental to the process of evaluation is the continuous consideration of (1) the pupil, (2) the instructional purpose, (3) the environmental setting, and (4) the developmental sequence of learning tasks.

THE CUTTING EDGE OF SCIENCE

Recent Developments in Research and Technology

Newcomers for Fighting Weeds and Insects

The chemical TCA (sodium salt of trichchloroacetic acid) has proved itself a worthy foe of perennial weed grasses in extensive field trials. It also shows promise in killing annual weedy grasses in certain TCA-tolerant crops, such as sugar beets, alfalfa, and other legume crops. Contact of the chemical with weed roots is essential, requiring application at a time of year when soil moisture conditions or rainfall can be counted on to leach it.

Allethrin is the coined name of a new insecticide that is highly effective against several kinds of insects, especially house flies and mosquitoes. The chemical is closely related to one of the four known compounds in pyrethrum. The discovery of allethrin and its commercial production within a year are welcomed for two reasons: (1) it provides "stockpile" insurance against a shortage of pyrethrum such as occurred during World War II; (2) development of resistance to DDT by flies and mosquitoes makes an effective alternate insect poison valuable.

Cleaning With Foam

"Froth-flotation," long used to concentrate metallic ores, is now being applied to cleaning peas, lima beans, and sweet corn prior to canning, says the U. S. Department of Agriculture.

The original problem was a real puzzle. Pea canners were unable to remove from shelled peas the berries of nightshade, a common weed in pea-fields. Mechanical shakers and screens would remove coarse trash and sift out fine weed seeds. But the nightshade berries were almost exactly the same size and color as peas. Worse yet, they had almost the same specific gravity, so that running a mixture into a tank of salt water to allow one to float and the other to sink would not separate them.

Scientists of the Bureau of Agricultural and Industrial Chemistry finally found the answer, based on the fact that the berries had a waxy coating and the peas did not. The peas, therefore, were more "wettable." A method of separation was devised making use of an emulsion of air, oil, water, and a detergent. The peas would sink, but the foam would cling to the berries and carry them to the surface where they could be skimmed off with the foam.

Sweet corn canners have a serious problem of culling ears and trimming kernels injured by corn borers and corn earworms. A modification of the froth-flotation method is promising excellent results by carrying away the injured kernels in the froth, leaving the sound whole kernels for packing.

Cerebral Palsy

A new program of basic research on the cerebral palsy problem has been launched by the University of Illinois College of Medicine. The study will give primary consideration to the basic problem of the mechanisms at work which produce symptoms of the affliction. First step will be to map out precisely the sites of damage in the brain and the distribution of transmitted impulses from those damaged areas. If this information can be obtained, it is conceivable that new methods can be developed along surgical or medicinal lines to aid the afflicted.

The affliction manifests itself in the patient as motor disfunction. Because of lack of coordination between muscle groups which activate the organs of locomotion and speech, the patient has great difficulty in walking, talking, and in using his arms.

Over half a million persons in the U. S. alone are known to have cerebral palsy. Some 10,000 are born annually, while additional thousands acquire it after birth. Due to lack of scientific knowledge, a shortage of trained personnel, and inadequate clinical facilities, only one child of each 100 now receives correct diagnosis and proper treatment.

"Blood Substitute" Being Studied

Biochemists at Emory University have successfully used a chemical substance known as "dextran" in treating over 50 patients needing blood plasma, according to a recent announcement. The chemical substance, made from fermentation of sucrose, is reported as valuable in re-establishing normal blood circulation when blood volume has been decreased. Inexpensive and requiring no refrigeration, the material would be easier to transport and stockpile than blood plasma. Say the scientists, "Much more study and experimentation are still needed, but we are optimistic." Dextran may be the means of helping save lives in cases of shock, accident, burns, or in atomic warfare.

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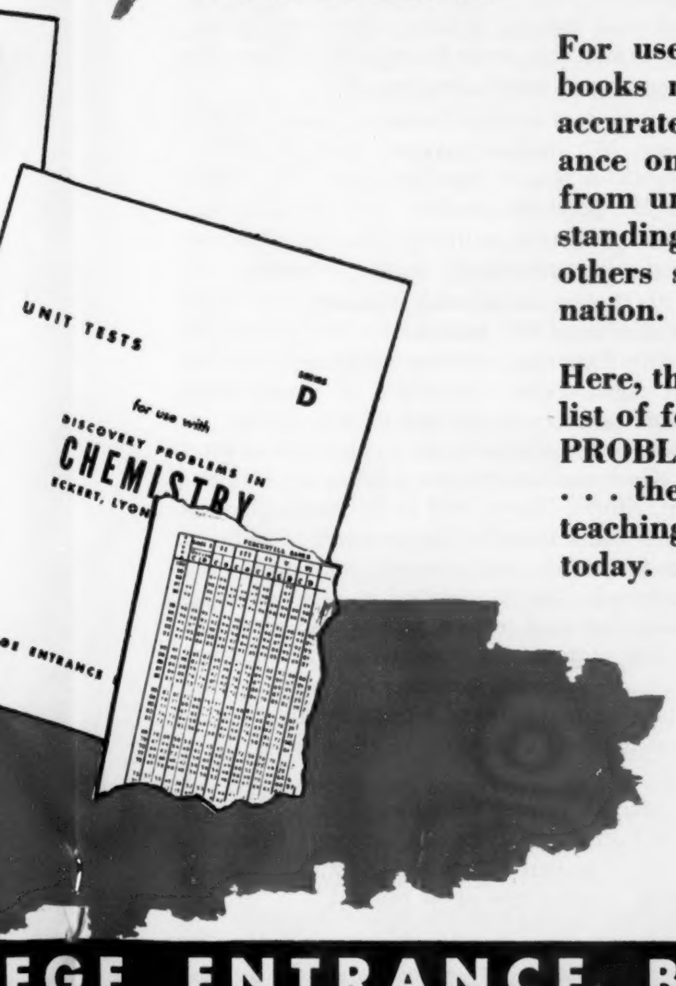

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PRECIPITATES

Announcements, News, and Views of Current Interest

A color movie, *Wonderland of Vision,* portrays the sciences and skills required to make eyeglasses. Includes unusual close-up shot of removal of pot of white-hot molten glass from a furnace. Available on loan from Bausch and Lomb Optical Company offices in Rochester, New York City, Chicago, and San Francisco, and from Better Vision Institute, 630 Fifth Avenue, New York City 20.

Six discussional slidefilms on *Matter and Molecules* designed for use with elementary aspects of physics are a recent addition to The Jam Handy Organization offerings. For information, write to School Service Department, 2821 East Grand Boulevard, Detroit 11.

A new and pioneering type of educational conference on instructional problems will be sponsored by the National Education Association and its various units at Toledo, Ohio, April 5–7. Approximately 600 invited classroom teachers and other leaders at all levels of education and in all subject matter fields, as well as representative laymen, will participate. They will come from Ohio, Michigan, and Indiana. "Never before," says Secretary Givens, "have the instructional resources of the NEA and its departments been so completely concentrated in one meeting." NSTA will be well represented in the meeting.

Brief but comprehensive is the report, *UNESCO—Five Years of Work.* Published in January, 1951, copies may be procured by writing to the U. S. National Commission for UNESCO, Department of State, Washington 25.

Better Living Through Wise Use of Resources, Bulletin 1950, No. 15, U. S. Office of Education, appears to be a most useful publication. Provides information and ideas for teaching about conservation and includes a 20-page bibliography of teaching materials and aids. Order from Superintendent of Documents, U. S. Government Printing Office, Washington 25. Price, 25 cents.

Current and Selected References on Conservation is a 16-page listing by Arthur W. Jorgensen published recently by the Wisconsin Conservation Department, Madison. No price indicated.

Vocational Guidance Manuals, Inc., of 45 West 45th Street, New York City 19, have recently issued their 1950–51 catalog of publications. Worth investigation by teachers with responsibilities or special interest in problems of guidance. Timely and with special appeal to science teachers are the new titles, *Opportunities in Atomic Energy, Opportunities in Photography,* and *Opportunities in Television.*

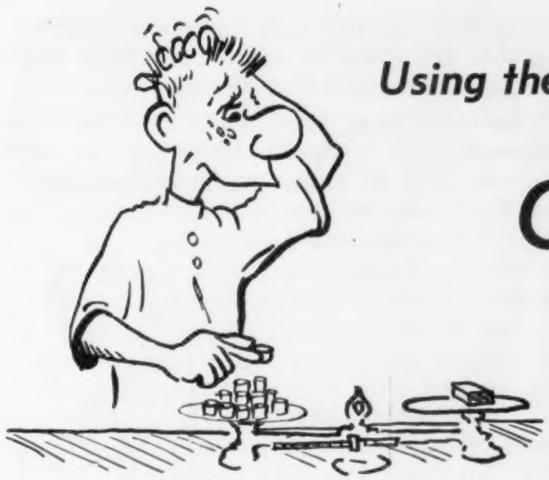
A new safety filmslide entitled *Health and Safety in the Out of Doors* has just been announced by Visual Science, Suffern, New York. Three dollars each, the filmslide includes 42 separate pictures in fields of safety concerning hiking, picking a camp site, snake bites, camp garbage disposal, safe water supply, boating, etc.

Announcement received from the Audio-Master Company, 341 Madison Avenue, New York City 17, tells about two of their products: the Audio-Master '51 playback machine and "Magiscope," a low-cost filmstrip projector. Further information available upon inquiry to the company.

A 12,000-mile, nation-wide Conservation Tour will be conducted this summer by the Division of University Extension in cooperation with the College of Agriculture, University of Connecticut. Interested teachers are invited to seek further information or for admission by writing to Dr. Raymond Kienholz, Coordinator University of Connecticut, Storrs. Travel will be by standard chartered bus and a traveling kitchen will accompany the bus to provide for hot meals at the camping spots selected. Cost is estimated at $450, covering transportation, food service, tuition, and necessary incidentals. Itinerary is expected to include visits to TVA, experiment stations, soil conservation projects, state and national forests, national parks, and similar places of interest in all sections of the country.

To obtain a helpful pamphlet, *The Ultraviolet Lamp in Education,* write to Ultraviolet Products, Inc., 145 Pasadena Avenue, South Pasadena, California. Copies free upon request.

(*Please mention* THE SCIENCE TEACHER *when you write*)



Using the Laboratory To Develop . . .

Critical Thinking

By GORDON M. DUNNING
Science Department
State Teachers College, Indiana, Pennsylvania

TO develop the ability to think critically is one of the objectives of education. Science, by the very nature of its materials and its methodology, would seem to offer fruitful avenues toward the realization of this objective. This is especially true of the laboratory period.

Criticisms are frequently made that the usual laboratory is conducted in a "cook-book" style or labeled "To prove. . . ." when in reality the activities engaged in *prove* little or nothing. Further, the assertion is often made that the laboratory should be the place for the student to do some original, inductive thinking. There are, however, too few concrete suggestions on how to accomplish the latter.

The following suggested approaches represent some of the more promising that the writer has attempted in providing an opportunity for critical thinking.

In the physical science class at State Teachers College, Indiana, Pennsylvania, considerable time is devoted to the historical or case history approach to science. What James B. Conant prefers to call the "Tactics and Strategy" of science is used as the central theme in carrying the classes through some original experiments, utilizing the data therefrom, and formulating tentative conclusions. For example, Boyle's experiment on the pressure-volume relationship of an enclosed gas provides not only a relatively simple set of data but also an excellent opportunity to illustrate the importance of controlling all the pertinent factors; or, in lieu of control, the variable factor must be taken into account when interpreting the results.

After the students have somewhat recovered from the shock of such an approach, they are presented with the following situation in the laboratory period.

"We wish to determine what relationships there are, if any, among such factors as volume, weight in air, weight in a liquid, and density of an object and the volume and weight of the displaced liquid."

All technical terms have been defined previously. The students are allowed access to any equipment but no book references where the answers might be found. Quite frankly, this approach may not sound too promising, but listed below are some of the incidents that took place in a single period. The reader may evaluate the worth of this approach from the accounts.

In weighing an object, the weights were added at random, with many exchanges off and on the scale with the final result of a large number of small weights remaining on the scale. When questioned, this group agreed that the method did not seem very efficient. After some consultation among themselves, they decided on what is the generally-accepted method of starting with the larger weights.

We have told you about Gordon Dunning already—in the January issue of *NSTA News Bulletin*. One of his firm beliefs about good science teaching is that objectives, methods, and testing should be coordinated and brought close together in daily practice. In this article he tells us how he capitalizes on opportunities to teach for critical thinking through the usual experiments done in physics. If you are interested in techniques of evaluating critical thinking, Dunning is another good man to get in touch with. Illustrations are by the author.

Another group placed the weights on the left hand pan and attempted to make the final adjustment by running the slider to the right. They were really puzzled as to the cause and procedure for correction. They "wasted" several minutes in arriving at the correct solution.

Another group properly balanced the scales but was in doubt as to which side of the slider should be used to read the scale underneath. In this case they could not think of any method to determine the answer, and the instructor finally had to tell them so that the experiment might proceed.

Members of still another group decided that they wanted to find the volume of a 100-gram brass weight but admitted that they did not know how to calculate the volume of a cylinder from its dimensions. After finding the answer (during which time the instructor had to explain the meaning of π and of squaring a term), the group measured the top diameter and height and calculated the volume. Then one member chanced to turn

the weight over and found that the cylinder was not solid but hollowed out in the bottom. They were completely baffled on how to proceed!

One more group carefully measured the three dimensions of a block of wood with a meterstick and calculated its volume to *six* decimal points. Needless to say, this provided a situation to teach the meaning of significant figures. The original intent was to float the block of wood in an overflow can provided. After completing all the measurements and calculations, they found the block of wood too large to fit the can. A simple preliminary observation or trial would have shown this to be true.

A sixth group floated a block of wood in an overflow can to determine the weight of the overflow water. They were quite chagrined to realize that they had forgotton to weigh the empty beaker first and were ready to repeat the whole procedure until one member suggested that all that was necessary was to empty and dry out the beaker and then weigh it.

Probably one of the finest lessons that came out of the period was when one group collected the following data:

Weight of wood	25 grams
Weight of overflow water when wood floated	20 grams
Difference	5 grams

The group was ready to write off the five grams difference as experimental error and come to the conclusion that the weight of displaced water *was* equal to the weight of the floating wood. One member, however, raised the point that five grams represented 20 per cent of the weight of the wood and 25 per cent of the weight of the displaced water, and that this seemed too high to her to accept as experimental error. "Possibly," she continued, "the five grams represents a *real* difference in the two weights, so the weight of the displaced water does *not* equal the weight of the floating wood." Finally she recommended the experiment be repeated and with a larger block of wood. (She got an "A.") It provided a most fruitful opportunity in which to recount similar situations that sci-

entists had encountered in performing original experiments and interpreting original data.

The above examples were those observed by the writer only and probably can be multiplied many times for the class as a whole.

Incidentally, this same approach is followed in the regular physics class. After almost all the members feel positive that an object will float only if it displaces it own weight of the liquid, the following demonstration is presented. An empty orange juice can, holding any object so that the total weight is 150 grams, is placed in a glass having only a slightly larger diameter and holding 100 grams of water. The can floats very nicely! This provides not only a further opportunity to discuss scientific attitudes and methods but also an excellent insight into the understanding of Pascal's Law.

The opportunities in the laboratory to teach the ability to observe accurately are many. One incident that occurred during the past year was when a student dropped a wooden croquet ball and a 12-pound shot from the fire escape. It was admitted that there might be some difference in rate of fall due to the effect of the air, but it was quite surprising to the class when the 12-pound shot consistently reached the ground noticeably before the wooden ball. Many were immediately willing to challenge the statement that all bodies fall at the same rate (neglecting friction). However, one alert member noted that inadvertently the student was releasing the 12-pound shot first, and, therefore, it had a head start. The balls then were rolled off a platform together and struck the ground at approximately the same time.

The use of analogies has become a common part of our every-day speaking and thinking. There are many opportunities in the laboratory to help students evaluate acceptable or unacceptable analogies. One example of this is used following the above case of freely-falling bodies.

A solid wooden disc and a metal ring, both having the same diameter and weight, are placed at the top of an inclined plane. The class is asked to predict which object will roll down the plane faster, or if they will roll at the same rate. With the experiment on freely-falling bodies fresh in their minds many will answer "at the same rate" and draw an analogy between the two situations. In this case the situation is ***not*** analogous, and the solid wooden disc will roll down the plane faster. Again this provides an opportunity to help evaluate the use of analogies and makes an excellent introduction to the concept of rotational inertia.

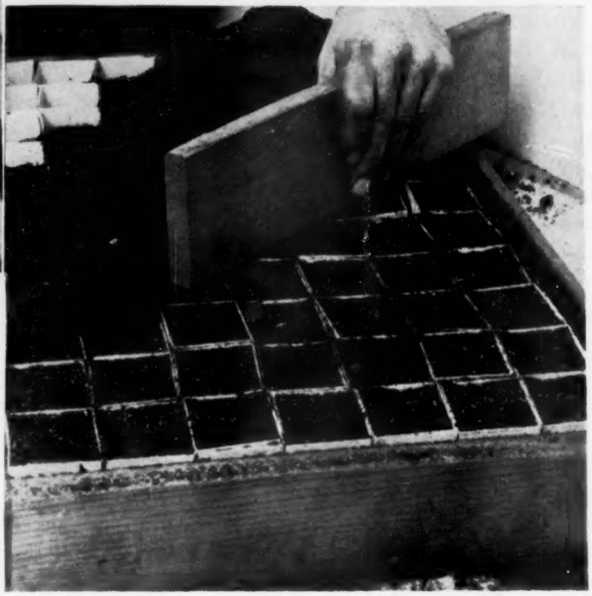
"The challenging of authority. . ." may sound more like a radical than a critical thinker. This seemed all the more true when, within the last six months, a member of the writer's class in elementary science challenged a statement in a leading elementary science book that if bare copper wire were wrapped around an iron nail and the wire connected to a dry cell the nail would not pick up a single thumb tack. Not content with accepting the statement without challenge, as was the remainder of the class, this one student conducted the experiment and found the nail picked up not only one but several thumb tacks!

The examples of teaching critical thinking in the laboratory can be continued many, many more times. It is hoped that the above offers a viewpoint worthy of consideration.

Of course, the teaching of critical thinking is not, and should not be, limited to the laboratory. A series of carefully-prepared, critical-thinking tests, followed by class discussions, holds much promise. In fact, the whole concept of critical thinking might well become a part of out-of-the-classroom experiences.

One small example that happened within the last semester occurred when a student was recounting the thrill he got out of a roller coaster. He described how the car was pulled up to the top of the first incline, after which it was free rolling. He went on to state that the first dip was not so great, but then the car coasted up the second incline until it ended at a greater height than the first, followed by a second dip that was really a "thriller." His story immediately came under fire by some members of the party.

GROWING FOR THE



Plant Band Division
George J. Ball, Inc.

In many communities a large proportion of the school pupils come from homes where a flower or vegetable garden is regularly grown. A project in growing early plants for use in these home gardens finds ready interest among students in biology or general science.

The obvious objective of a project of this sort, the production of plants for use in home gardens, does not impair its value as a means of teaching many basic principles of plant science. It gives the learning a practical, real-life background and purpose.

The primary need for a sucecssful project of this sort is a place to start the seedlings and grow them to transplanting size. A conservatory or growing room, such as some biology teachers have available, is ideal, but broad sills in windows facing south will serve satisfactorily. Windows facing east or west may be used if nothing better is available, but they will not grow as stocky seedlings as those providing a full day of sunshine.

Most practical containers for starting seeds under such conditions are shallow clay pots, such as the florist calls "bulb pans," or "azalea pots." The former are best because they have the least depth, but the azalea pots are satisfactory and generally easier to obtain. Get them from a greenhouse or florist. The five-inch and six-inch sizes will usually work out best.

As the medium for starting the seeds I am recommending vermiculite, sold for horticultural uses under the trade names "Terralite," "Agrilite," "Mica-gro," etc. This material is sterile, so it does away with losses from damping-off disease, a bugbear when soil is used. It also simplifies the matter of watering as it holds moisture sufficient for several days under ordinary conditions. Most garden supply stores now stock this material. It can be bought most economically in two-bushel bags, which weigh about 15 pounds.

For transplanting the seedlings out of the germination pots, the modern two-inch "plant bands," made of wood or treated paper, are ideally suited for a project of this sort. These are illustrated in the introductory illustrations. They may be purchased from many local garden supply stores and the larger mail order seed and supply houses. Two types are widely used. One is made of treated paper and sold under the trade name of "Vitabands." Others are made of wood veneer. Both are scored to fold into a square, bottomless box or band.

Plant bands are made in various sizes, but the size of greatest general use is two by two inches square and two-and-one-half inches deep. These bands are purchased in flat form, but stapled or

EARLY PLANTS HOME GARDEN

By PAUL R. YOUNG
School Garden Supervisor
Public Schools, Cleveland, Ohio

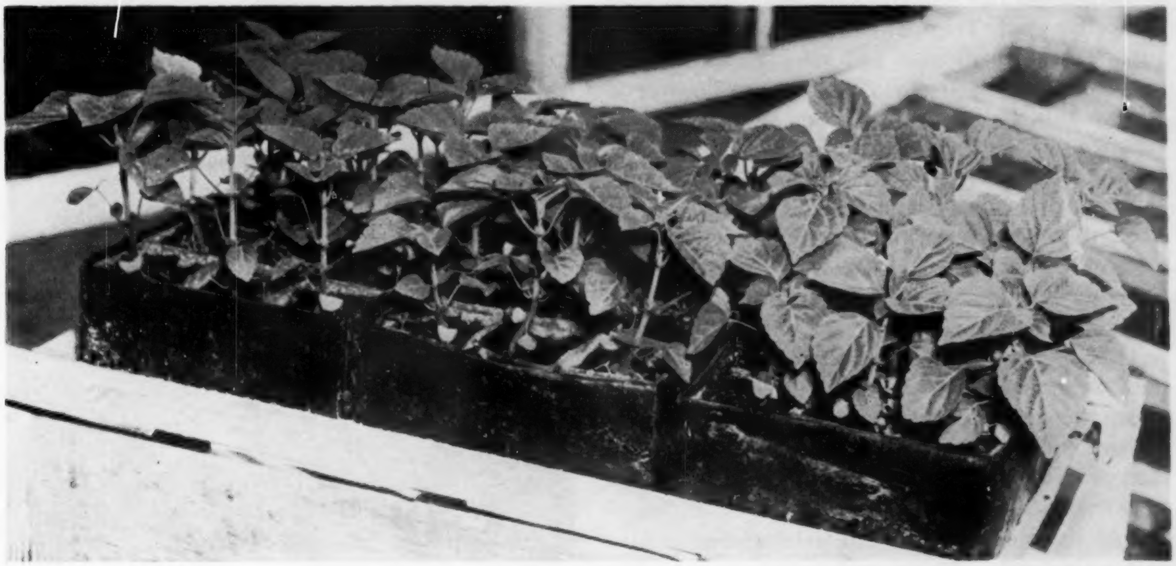
On problems relative to gardening Paul Young can speak with authority—authority that grows out of special training and study and many years' experience as school garden supervisor for the Cleveland Public Schools. Mr. Young also writes the *School Gardengram,* which many NSTA members now receive regularly. He has served on the NSTA Board of Directors.

The ideas and procedures Mr. Young gives in this article are timely and practical. They can be used with pupils at elementary and secondary levels, by teachers themselves, and all other persons interested in gardening. And Mr. Young claims that more people now use leisure time in gardening than in any other single avocational activity.

glued so they can be readily opened up for use. When opened they are set in shallow wooden boxes (flats), as shown in the picture below, and filled with soil. Of especial use for a school project in plant growing are the small paper or wood veneer trays pictured, which may be purchased with the bands. They hold a dozen bands and make convenient units for handling.

Seeds, pot labels, soil for transplanting, will about complete the list of supplies. Do not attempt too many kinds of plants. Three flowers and three vegetables are enough for the first time. One or two retail packets of a kind should be enough for a single class, except in the case of hybrid varieties, packets of which are very scanty. Six-inch pot labels will be best. Soil for the transplanting should be good. A mixture of equal parts garden loam, sand, and some organic material like compost, rotted manure, or peat moss, with a handful of commercial fertilizer to each bushel of the mixture, will give good results.

Do not start this project too early. It is difficult to keep plants safe over week-ends in school build-



Bird & Son, Inc.

Salvia plants in paper bands and paper flats or trays holding 12. This is a most convenient way to grow and handle garden plants.

ings when really cold weather is a possibility. Then, too, the final phase of the plant growing must be completed at the homes of the pupils. When the transplanted seedlings go home the season should be far enough advanced so that the boxes of plants can be set outdoors and brought inside only on occasional days or nights when bad weather and cold threaten.

Plan to have the seedlings ready to transplant about three weeks before it is safe to put them in the open garden. In Cleveland this means about the first week in May, for we can set out plants in safety about the fourth week in May.

The time required from seed sowing to transplanting into the soil in plant bands varies with different kinds of plants. For petunias, snapdragons, ageratum, verbena, salvia, and peppers, allow about four weeks. Three weeks, or less, will be enough for tomatoes, cabbage, broccoli, head lettuce, marigolds, zinnias, cosmos, asters, and seedling dahlias.

Sowing seeds in vermiculite is easy. Put a piece of broken pot over the drainage hole in the bottom of the pot to be planted, and fill the pot with vermiculite to within three-quarters of an inch of the top. Firm it down slightly with any flat surface, such as the bottom of another pot, to make a level surface for the seed.

Scatter the seeds evenly over the vermiculite, not too thickly. They may be shaken out very carefully, over the lip of the seed packet, or scattered a pinch at a time with the thumb and finger.

Tiny seeds like snapdragons and petunias need not be covered. They will rattle down among the particles of vermiculite and need no other protection. Larger seeds should be covered by sprinkling a *thin* layer (not over one-eighth inch) of vermiculite over them after they have been sowed. Label each pot with a pot label showing the name of the plant, variety, and date of sowing. If desired, the name of the pupil or pupils who sowed the seed can be added on the reverse of the label. Push it well down and close against the side of the pot.

To start the germination process, set the planted pot in a vessel of water two or three inches deep. When the surface of the vermiculite becomes moist, remove the pot from the water, let it drain, and then place it on a warm, sunny window sill or on a conservatory bench.

One watering like this will last for several days unless the sun is bright and temperatures high. When the surface begins to feel dry and loose again, set the pot in water as before.

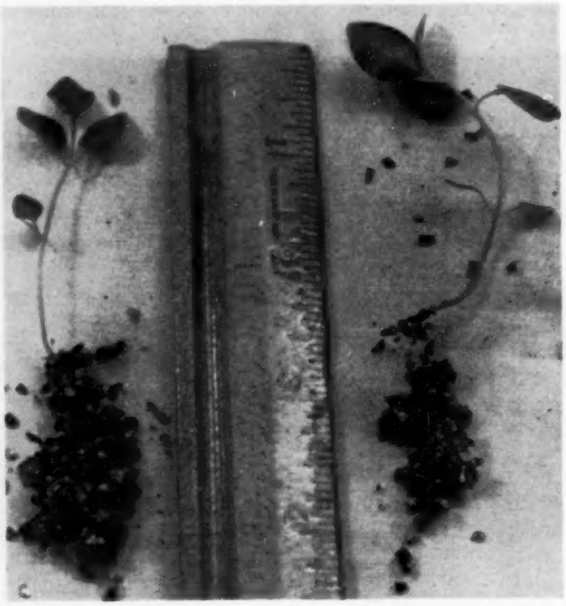
Many seeds will sprout in four or five days in vermiculite, others take a week or more. This material provides ideal conditions for germination in that moisture and air are available to the seeds in optimum quantities. If the temperature is right, germination is very rapid.

Continued watering as needed, plenty of light, and one or two feedings with liquid fertilizer will bring the seedlings along rapidly.

Vermiculite contains no plant nutrients, so, after the seedlings have used up the storage of food that the seeds contained, they must be fed. This is done by watering them once or twice, at weekly intervals, with water containing fertilizer in solution. Such a solution can easily be made by stirring four teaspoons of an ordinary complete garden fertilizer into a gallon of water in a pan or jug.

The rate of growth of the seedlings can be held back somewhat, if desired, by withholding water for longer than normal periods. The vermiculite will not dry out to the wilting point of the plants for a long time, but the growth will slow down if water is withheld below the optimum.

All the light available should be given the growing seedlings. Temperatures not over 70° during the day are best. Inadequate light and too much warmth are the chief causes of "leggy," weak seedlings. Stocky, sturdy seedlings are the ideal.



Wyodak Chemical Co.

Snapdragon seedlings grown in vermiculite. Note the granules attached to the roots.

When the seedlings have one or two pairs of true leaves they are ready for transplanting out of the vermiculite into soil.

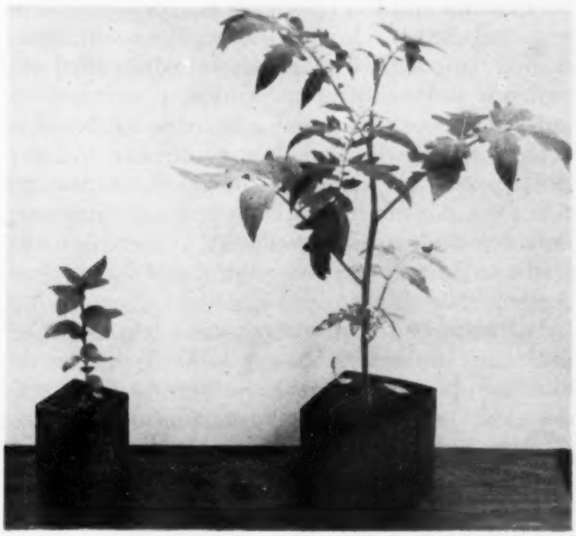
Fill the plant bands with soil as shown in the illustrations. Firm it down lightly in each band with the end of a square stick. Write the name of the plant, variety, date of sowing (from the seedling pot label), and date of transplanting on a new pot label and put it in the corner band in the flat or tray to be planted with that variety.

Seedlings can be lifted out of the pot of vermiculite by getting under the roots with a pot label or spoon. They will come up with a mass of vermiculite particles adhering to the roots, held by root hairs which have grown into the interstices of the vermiculite. These clinging particles of vermiculite provide moisture so that the seedlings seldom wilt during the transplanting process. (See picture of snapdragon seedlings on facing page.)

Separate the seedlings carefully, so as not to tear the roots. Holding a seedling in the left hand, open up a hole in the center of the soil in a plant band, using a pencil as a dibble. Then drop the roots of the seedling into the hole and firm the soil around them. The seedling should be let down a little deeper than it was growing in the seedling pot. Repeat this process for each plant band. When the flat or tray is filled, water all the plants well to settle the soil down around the roots.

Instead of trying to provide space for growing all the pupils' seedlings in the school, it is better to let each take home those he has transplanted for his home garden. They can be put in a sheltered place near the house, preferably on the south side, and left there unless frost or a bad storm threatens. Then they can be carried indoors for a night or a day or so, to protect them, and taken out again as soon as conditions allow. For the first two or three days the newly-transplanted seedlings should be protected from direct sunlight.

Regular watering will be needed, of course, but with this care the plants should develop and be ready for setting out in the garden within the three weeks suggested in the timing schedule.



Plant Band Division
George J. Ball, Inc.

Snapdragon and tomato plants ready for setting in the garden. Growing in paper Vitabands.

Georgia Committee Studies Science Teacher Education

What should be included in the pre-service educational program for science teachers? What do science teachers do in the secondary school that colleges can prepare them to do more adequately? These and similar problems are being considered by the Science Committee of the Georgia Teacher Education Council. Several studies on the state and national levels have been reviewed, and these have been helpful in formulating the problems.*

Some lines of attack are: questionnaires and interviews with selected science teachers; questionnaires and interviews with college teachers of science; review of literature, research, and reports of evaluation committees in the state; study of science curricula; interviews with teacher preparatory institution graduates; and pupil-parent opinions as to needs and work.

Composition of the committee involves a cross section of interested people in science from all sections of Georgia. Representatives from the State Department of Education, teacher preparatory institutions, college science teachers, supervisors of science in secondary schools, and high school science teachers comprise the advisory committee. Sub-committees include lay persons, parents, and industrial people.

The committee hopes to have a preliminary report ready by June, 1951, and a final report ready by June, 1952.

* The two studies which have been most influential in the thinking of the committee are: (1) Johnson, Philip G. *The Teaching of Science in Public High Schools.* Federal Security Agency, Office of Education. Bulletin No. 9. Washington, D. C. 1950. (2) Hall, Ralph H. *A Critical Study of the Science Programs in Georgia Secondary Schools.* Unpublished Doctoral Dissertation. The Ohio State University. 1950.

Industrial and Technological Resources Aid Science Teaching*

IN A TRULY dynamic school learning situation it is impossible to separate classroom activities and interests from out-of-school influences. Indeed, it is necessary in our modern technological society that we utilize fully in every possible way the resources available. The following discussion is not represented as being the ultimate in either desirability or possibility—it is just the report of one classroom teacher's experiences in stimulating thought, action, and discussion in what appears to be a somewhat neglected area of relating science to general education: the fullest use of industrial and technological resources.

Field trips are perhaps the most abused and underused area in the field of technological resources. For purposes of discussion field trips may be divided into three general kinds—local, area or regional, and extended. Let us begin with the last.

The extended trip is not a new idea in the field of education. So far as I have been able to find out, however, the extended trip granting credit has not been used for high school pupils with the specific idea of studying the applications of science in industry. A detailed description of such a trip lasting three weeks and touching some 20-odd states will be offered as a possible guide.

It was on our return from a three-day regional trip (described later) that a co-sponsor, Mr. Lloyd Conyers, and several students and I mentioned what fun it would be to take a longer trip of similar nature. Then and there "Operation Junetrip" was born.

On the Monday following the regional trip I was in the office of the superintendent to report on that trip and to explore the possibility of "Operation Junetrip." It was decided that such an extended trip would be a wonderful educational experience and might even be used as a course in applied science. A request was made to the state department of education for permission to offer the trip as an experimental course, and authorization for a half-unit credit was granted. However, only one student was specifically interested in the credit to be received; the rest would have taken the trip regardless.

We estimated that a three-week trip could be made for between \$150 and \$200. With this in mind, and after informal discussions with students, a tentative state-by-state itinerary was planned and letter writing started. We requested travel information from the highway department in each state to be visited; we contacted many Chambers of Commerce in large cities, state

* Based on Mr. Taylor's paper presented December 29, 1950, at a joint session of the AAAS Science Teaching Societies, Hotel Statler, Cleveland, Ohio.

By WAYNE TAYLOR
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Senior High School, Denton, Texas

Chambers of Commerce, and state Development Commissions. We wrote to trade organizations such as the American Iron and Steel Institute, the National Association of Manufacturers, and many others, for all available information. Travel services of several major oil companies were requested, and through these many more contacts were made. It might be mentioned in passing that the Conoco Touraide proved to be a veritable gold mine of information. Most of our hotel reservations were made through a study of their listings.

The response to these preliminary inquiries was immediate and highly encouraging. We found that the major industries, in the main, were ready, willing, and able to cooperate in every way possible.

As the printed material began to come in it was filed by state and city, and a concrete itinerary began to take form. After the route had been decided through group and individual discussion with those likely to make the trip, definite letters of reservation were written and final plans made.

Meanwhile, some of the students had started saving their money, others arranged for summer jobs after the trip was over, and many persuaded the parents (with my help) that the trip was really an investment in a good general education for the child making the trip. We set no rigid science prerequisites for the tour and, as a result, many of the students who went had not had any science or, at best, only general science. Several, however, had had biology and/or chemistry. None had had physics. One junior high school student (whose mother was going as a chaperon) and two college students were permitted to go.

In addition to the many informal talks and small group meetings, there were three formal meetings to which the parents were invited. At these meetings rather definite rules were set up with the approval of the group, and mechanics of the trip were discussed. For instance, it was agreed that students would abstain from eating peanuts, candy, etc. between meals, particularly while on the bus. Although this was not rigidly adhered to, students in the main were careful about it.

Other things discussed at the meeting included dress for the trip, ways of caring for laundering, the amount of baggage that could be taken, types of meals that should be eaten, how spending money should be handled, setting up standards of conduct, planning the best way of keeping a record of where they had been and what they had seen, and keeping their parents informed of their experiences.

It was decided that materials that were easily laundered would be most practical—such things as nylon and seersucker—and that each student would try to keep underwear and these materials clean by washing them at night. It was planned to have a laundry stop about the middle of the trip for things that could not be handled in this way. As we know now, this was a mistake, for we still have not recovered all the clothes from a "one-day service" laundry in Washington. On future trips we shall either find a "do it yourself" or do without.

In the general meetings the question was raised about what would happen if one of the boys or girls became ill en route and had to be left behind. Since there were to be four adults along, it was decided that one of them could be left if necessary. It was recommended that participants who did not have health and accident insurance take care of this problem individually. No group policies were

GIVEN: Twenty-five high school students. four adults, $6000 in traveler's checks and cash, a chartered bus, a well-planned itinerary, and three weeks' time. What educational results may be expected? Wayne Taylor, in this article, tells his story of such an adventure.

Mr. Taylor has been teaching for ten years, two of them in his present position. A graduate of North Texas State College, he has the distinction of being the first "product" of the Junior Academy to become an officer (secretary) of the Texas Junior Academy of Science. Last summer, after "Operation Junetrip," he began work on his doctorate at Teacher's College, Columbia University. Mr. Taylor has served two years on the NSTA Committee for the Evaluation of Business-Sponsored Teaching Aids.

Such interest has been shown in the use of extended field trips for teaching that Mr. Taylor is conducting a trip similar to "Operation Junetrip" in June of 1951 that is designed for teachers. The participants will enroll as a graduate workshop through Texas State College for Women and will receive three hours graduate credit in secondary methods. The course is recommended for both natural and social science teachers and will be coeducational.

found that were satisfactory to the students making the trip.

A month before the actual starting day of the trip, each student deposited $60 for transportation expenses. This was non-refundable. In addition, two days before the trip, each student brought his $100 balance that was to be used for his rooms and meals. It was found that the rooms averaged $2.50 per day, and $2.50 per day was allotted for meals. The meal money was issued daily to the students, and hotel bills were paid by the sponsor.

A mimeographed roll was made before the start of the trip, and this proved to be one of the handiest items available. On arrival at a hotel, one copy was kept by the sponsor and one handed to the reservation clerk with room numbers designated on each. This eliminated much lost time and motion in registering the group and in collecting room service charges, etc. We imposed no restrictions, in general, on room service and telephone calls, but a few of the hotels did. Needless to say, some of the boys and girls were quite unhappy in these situations.

The trip lasted three weeks and required nearly 5000 miles of travel. We made 44 major stops.

Students Report on Visits

Space does not permit a detailed listing of all the industries and flow of materials we saw, but the following examples have been selected from on-the-spot student reports to show the amount of information gleaned and, in some measure, the comprehension of the processes. These reports were written on clipboards as the students went through the plants.

A senior boy wrote this about the Armstrong Cork Company, Jackson, Mississippi, manufacturers of asphalt tile:

"The plant operates three shifts per day, six days per week. The raw materials used are asphalt, limestone, gilsinite, and coloring. For freeze-proof floors cumar is also used. The materials are brought to the third floor of the plant by a 12,000 lb.-capacity freight elevator. On the third floor the materials are mixed in batches of 900 lbs. per batch; 400 lbs. of this is scrap, 500 lbs. raw materials. Each batch is then dumped through a hole in the floor which goes down to the mixers on the second floor. When the materials are mixed, they are passed down to the first floor into heating and rolling machines which roll the mixture into a thick slab, perhaps three feet wide, which then goes by a conveyor belt to another machine which presses it out to its proper thickness.

"It then goes to a stamping machine which cuts out each individual square. On either side are inspectors who pick up any waste material and cull tiles to be taken back to the third floor, chipped up to the size of a 50-cent piece, and mixed for a new batch. The sound tiles are then packaged by a complicated machine which automatically counts, packages, seals, and weighs the finished product."

Rayon Plant Rouses Interest

A junior girl filled in her industry report blank on the du Pont Rayon plant at Old Hickory, Tennessee, as follows:

"Points of Interest: They take care of their own machinery and produce their own power. Make 48 million lbs. of rayon a year.

"What did you learn from this visit?: Process for making rayon. In the rayon department the divisions are viscose, nylon, and acetate. 5000 different products made in the du Pont plants. Rayon only completed as far as white thread and is sold to other industries to be dyed, woven, etc. In a $1.25 pair of hose only 11¢ is nylon."

The students visited other comparable industries where they saw other means of modern mass production, ways of handling different materials, and types of working conditions. They saw comparable industries operated as governmental and private enterprises. In addition they saw the physical characteristics of the regions they visited and had an opportunity to observe regional characteristics of the inhabitants.

Objectives and Outcomes

What did the students "get out of it" is a proper question. And for light on the answer, let's turn again to some quotes from student reports.

The first general objective of "Operation June-trip" was to provide an understanding of the role of industry in shaping the physical environment of the American people. Wrote one student: "What does the United States consist of? Factories and industries that make our living more comfortable and easy. Good, kind, and understanding people who hang a welcome sign in front of their door to people all over the world. Memorials and monuments dedicated to the people of long ago who helped make America. These things and many more are what our United States consists of."

The next objective, to gain a realization of the impact of modern scientific methods in utilizing natural resources: "More than half a billion gallons of water daily are taken from the Detroit River for the Rouge Plant." "The Kellogg Com-

pany uses approximately 19,000 bushels of corn daily." "Gulf States Paper Company uses local pine trees for making kraft paper." "I did not know there could be so many different types of machines for cutting wood for the finished product."

The third general objective, to allow each individual student the opportunity to investigate for himself both similarities and differences in the regions visited, with particular emphasis on the physical, social, and economic variations, had many, many applicable statements: "Some of the people that we saw and met seemed very different to me. They are different in their talking, their living, and in their food. Their living is different from ours because in the big cities, such as Boston and New York, they live very close together, usually in apartment houses with no lawns or trees. In the South we, or that is most of us, live in houses with lawns and trees."

Special Insights Gleaned

Another general objective, to give each student participating a background for intelligent action as an American citizen in political, social, and economic questions, is difficult to evaluate immediately, but several of the students made statements relating to it. Of du Pont Rayon, "They had unions, but du Pont didn't seem like the monopolistic power that it had been pictured to me as being. Working conditions appeared to be tops, and a safety emphasis was noted." Of a waterways project, "A pier owned by an electric company at Port Washington, Wisconsin, furnished enough revenue to support the schools of the city." "The way the Senate session was carried on was a surprise to me." Of the Museum of Science and Industry, "If a school could have all the instructive ways of teaching that are in the museum, kids would get along much better."

Sidelights Noted

Other noteworthy results were these: The students asked penetrating questions of the factory representatives about working conditions, salaries, raw materials, products, and distribution.

The conservation of natural resources was touched on time and again by factory representatives as we traveled from one region to another.

The dependence by industry on the presence of, or easy access to, basic raw materials, power, and water, was one of the prime points stressed by every industry visited, from iron ore, coal, and limestone in Birmingham to copper, coal, and labor in Schenectady.

Another thing that grew out of the experience, although it was not listed as a formal objective, was an increased social awareness of other people's characteristics as individuals and some of the privileges and responsibilities of group living.

Local and Area Field Trips

The local trip may be either a single class period, such as a trip to the power plant by the physics class, or a local trip taking more than a class period. An example of the latter would be a half-day tour of local industry sponsored by the Chamber of Commerce. Area or regional trips may be for one or several days. The one-day trip might be a visit to a nearby industrial center that has a variety of industries, while the overnight trip should be used for the purpose of visiting several industries of particular interest and importance that are too far away for a one-day drive. For example: The Denton Chapter of the Texas Junior Academy of Science was planning to attend the state annual meeting in Houston, and some of the members asked if they might see a few things along the way. This was the opening wedge of a sponsor's dream for a well-rounded science experience. After the trip was definitely scheduled, a bus was chartered and prospective places contacted. The first night was spent at the Country Campus dormitories of the Sam Houston State College at Huntsville. An early start the next morning gave enough time to visit the Wharton County jail where federal prisoners are kept in South Texas. Sheriff "Buck" Lane took the group through and talked about scientific crime detection. When the bus arrived at the town of Newgulf, a representative was waiting to conduct a tour of the Texas Gulf Sulphur Company. The Bureau of Mines film on sulfur was brought to life as the group went through the power plant and saw immaculate rows of gas-fired boilers and electric generators. They saw the water purification system and had explained to them the necessity for pure water to be used in the boilers. The experience of seeing three blocks of solid sulfur, each block five stories high and large enough for three full-sized football fields on top, was overwhelming.

After lunch at the Boling High School cafeteria we were off to Freeport where we saw one of the best integrated chemical processes imaginable at the magnesium plant of the Dow Chemical Company. The students started where the barges brought in the oyster shells. The shells were unloaded and pulverized, then passed to a kiln where a natural gas flame is used to heat them and drive off the carbon dioxide to leave calcium oxide. The

CaO is in turn added to the sea water to precipitate Mg^{2+} as magnesium hydroxide. The $Mg(OH)_2$ is then drawn off, and hydrochloric acid is added to form $MgCl_2$. The magnesium chloride is dried and the magnesium is separated electrolytically.

The next day (Saturday) was spent in presenting and listening to scientific papers at the Junior Academy meeting. On the way home a co-sponsor, Mr. Lloyd Conyers, and several of the students and I—but this is where we came in: "Operation Junetrip" was born.

Other Industrial Resources

By far the most commonly-used technological resources are the printed materials that are furnished by industrial concerns, trade organizations, government agencies, and other groups or organizations interested in particular topics or fields. Undoubtedly many excellent materials never find their way into a classroom because the teacher is not aware of them or does not have (or take) time to relate them to his program. On the other hand, many materials do find their way into the classroom that might be better off in the incinerator because of poor presentation, "slanted" treatment, or excessive advertising. Fortunately the National Science Teachers Association is doing much to alleviate this situation through its broad program of Industry-Science Teaching Relations.[1]

With increasing emphasis on proper preparation of materials and investigations of uses to which the materials are put, this area should improve steadily. In the final analysis, however, the classroom teacher is personally responsible for determining whether a particular item is the best thing available for him in his school, *and his school alone,* for what he wants to accomplish and, if so, how he can use it to best advantage.

Films and filmstrips are useful for showing the manufacture and application of materials in many industries. As with printed materials, exhibit materials, films and filmstrips should be used only when they have application to the dynamic situation.

The use of resource visitors in schools is not new. We have used resource visitors for science club programs and also to some extent in classes. For example, a physicist who had done special work in use of radioactive materials brought a Geiger counter, demonstrated some radioactive materials, and gave a very interesting talk on radioactivity.

Outside use was made of a resource person when two of the boys made regular trips to the police station for several weeks for instruction in fingerprinting from the local expert. The boys then reported back to the class on their new knowledge.

It is my conclusion that we should include industry in our science courses. By the combined use of field trips when possible, films and filmstrips, and printed materials, a well-rounded teaching job can be accomplished that cannot be achieved through the regular textbooks and formal laboratory exercises alone. Integration to me means the application of all resources available, whether they be in or out of the classroom, so long as they are applicable to the job at hand—the understanding by our students of the role of the wonders, applications, and effects of science in our culture.

[1] This program embraces "CEDUR"; "C" for consultation, "E" for evaluation, "D" for distribution, "U" for utilization, "R" for research. There is also an Advisory Council on Industry-Science Teaching Relations and a Business-Industry Section of NSTA.

Moral and Spiritual Values

Personal integrity, honesty, and self-discipline are cited as among the most important moral values for which the schools should teach in the newest report of the Educational Policies Comission. Entitled *Moral and Spiritual Values in the Public Schools,* the 100-page statement was prepared as the result of a two-year study that included conferring with many teachers, school administrators, and authorities in other fields.

No society, the commission asserts, can survive without a moral order. "No improvements in government structure, no statues or ordinances, however lofty their aims, can produce a good and secure society if personal integrity, honesty, and self-discipline are lacking," it states. "The necessity for attention," the report continues, "emerges again and again as consideration is given to the social effects of recent wars, the mounting complexity of government, the increasing amount of aimless leisure, the changing patterns of home and life, and the current international tensions."

The commission lists the following ten values on which it believes the American people are agreed: human personality—the basic value, moral responsibility, institutions as the servants of men, common consent, devotion to truth, respect for excellence, moral equality, brotherhood, pursuit of happiness, and spiritual enrichment.

The commission observes that "it has sometimes been suggested that the religious beliefs shared by all

churches be taught in the public school. However, an inquiry into this possibility reveals no substantial *agreement* on *religious,* as distinguished from moral and spiritual, questions. Not even the reading of the Bible, nor even the reading of the Old Testament, can be brought within the area of 'agreed' religion. Further, it is necessary to respect the fact that although the Christian denominations together have more adherents than any other religious group in the United States, our public schools serve no inconsiderable number of people of other religious faiths, as well as those who claim no religious affiliations or convictions whatever."

The point of view is taken by the commission, however, that the public school "can teach objectively *about* religion without advocating or teaching any religious creed. To omit from the classroom all references to religion and the institutions of religion is to neglect an important part of American life. Knowledge about religion is essential for a full understanding of our culture, literature, art, history, and current affairs."

"The public schools," the report concludes, "will continue to be indispensable in the total process of developing moral and spiritual values. They can and should increase their effectiveness in this respect. Their role is one that no other institution can play as well or at all. But the public schools cannot act every part in the complex drama of personality formation. Any hope on the part of the general public that schools can do the whole job unaided is doomed to disappointment. Any attempt on the part of the teaching profession to assume such a staggering responsibility would be certain to end in frustration. The public schools need partners."

The report is available from the Educational Policies Commission, 1201 Sixteenth Street, N.W., Washington 6, for $1.00.

BOOKS BOOKS BOOKS BOOKS Review

Vitalized Chemistry. Russell T. Des Jardins. Revised. 374 pp. 75¢ (paper bound). College Entrance Book Company. New York. 1950.

Vitalized Chemistry is designed as a learning aid in day-to-day study of chemistry and affords a convenient review for both teacher and pupil. It is printed in graphic color. This two-color printing enhances the value of this popular review book in chemistry by calling attention to the essentials that a student should note. *Vitalized Chemistry* is much more than a review book because of the selected text material accompanying the 20 chapters dealing with the usual topics treated in standard chemistry texts. The all-important topic of nuclear chemistry is well done and is treated in the atomic theory chapter to reflect the developments and theories pertaining to atomic fission and atomic power.

GRETA OPPE
Ball High School
Galveston, Texas

Everyday Machines and How They Work. Herman Schneider. 192 pp. $2.50. Whittlesey House. New York. 1950

Rarely has such a small book encompassed so much, for Herman Schneider's concept of machines is a broad one. His pages are jammed with explanations of trombones, cylinder locks, water heaters, bubble lamps, meat grinders, mousetraps, and metallic thermometers. Dozens of devices, machines, and gadgets are examined in a grand tour of everyday things conducted by a master guide whose science books have been as widely used by teachers as by the children for whom they are written.

The wide range of unorthodox content does not imply a haphazard compendium or a believe-it-or-not anthology. Schneider makes constant reference to basic ideas and their application—to screws, springs, gears, expanding liquids and solids, the transfer of heat, and the flow of current electricity. Jeanne Bendick's informal illustrations catch the spirit of the book and clarify many points. This is a book that any boy or girl—or even any teacher of elementary grades—will enjoy, for it leads on and on from one curious fact to another. There is much in it that the teacher of secondary science will be glad to learn also.

It will not be carping to point out that the book has limitations a science teacher will notice. Because explanations are simple, it is inevitable that some are superficial, though the accuracy of the book is commensurate with its purpose. Any mention of air conditioning, electric clocks, and internal combustion engines escaped me. The newer methods of heating houses are slighted, but as compensation one learns the structure of a match, the operation of a vacuum coffee maker, and the difference between a violin and a mandolin. I'd vote this book a place on any science bookshelf.

HERBERT S. ZIM
University of Illinois

BIOLOGY. Revised. Brother H. Charles (Charles F. Severin). 522 pp. $2.96. Bruce Publishing Company. Milwaukee. 1950.

This high school biology textbook stresses the interrelation of the life functions of plants, animals, and man. A revised edition, it presents some major changes from the original. The chapters have been grouped into units, the better to emphasize the essential similarities in the biological functions of plants, animals, and man.

There is an excellent introductory chapter outlining the diversity of living things and the general plan of biological classification. The characteristics of each phylum are presented in simplified form which should serve to encourage students in learning their general classification, rather than to frighten them.

The study of plants is included in the unit on nutrition, and the treatment of plants is limited almost entirely to their function as food factories.

Treatment of reproduction in animals is weak and scanty in its presentation, as is the treatment of evolution.

Each chapter concludes with a list of important words which should be mastered, a list of books for supplementary reading, and a list of projects. Some of these latter are intriguing, but many appear somewhat elementary for high school youngsters and emphasize reading and collecting clippings, rather than action or experimental projects.

RICHARD H. LAPE
Amherst Central High School
Snyder, New York

Elements of Chemistry. Raymond B. Brownlee, Robert W. Fuller, Jesse E. Whitsit, William J. Hancock, Michael D. Sohon. 680 pp. $3.00. Allyn and Bacon. New York. 1950.

This is one of the first textbooks for high school chemistry to appear which approaches chemistry from the viewpoint of atomic energy. This motivating theme is closely integrated in each chapter of the book. It stresses the importance of the nuclear process and the peace-time benefits of atomic energy.

It discusses tracer isotopes, giant molecules, polymers, plastics, synthetics, silicones, stratospheric rockets, jet propulsion, antibiotics, and other timely topics. A whole chapter on "Chemistry in the Home" emphasizes the close correlation of chemistry with everyday life.

Many up-to-date photographic illustrations along with nine full-page color photographs highlight the text materials. The style is clear and direct.

Among the study helps is a new chart of the 98 elements, and many useful up-to-date tables in the appendix. It contains self-testing exercises, thought questions, and other student helps. It will provide ample material for the college-bound chemistry student but will be found lacking in many ways for pupils whose formal education terminates with high school.

HUBERT J. DAVIS
Norfolk County Schools
Portsmouth, Virginia

The Human Reproductive System. Thomas H. Knepp. 50 pp. 60¢. Wm. C. Brown Company. Dubuque, Iowa. 1950.

This booklet is the amplified and revised mimeographed text which Mr. Knepp used in his teaching at Stroudsburg High School, Stroudsburg, Pennsylvania. It is an accurate account of the human reproductive system, and its contents and extent of coverage are represented by these sections: Puberty and Adolescence (two pages), Male Reproductive System (eight pages), Female Reproductive System (11 pages), The Sex Act (three-quarters page), Human Embryology (17 pages), Pregnancy (two pages), Birth (three pages), Multiple Births (one-half page), Periods in the Life of Man (one-half page).

The reviewer thinks this is a useful booklet. However, the vocabulary is slightly above the tenth year. Also the diagrams of early embryology are not as meaningful as they might have been if more space had been allotted. This is also true of the sections titled: Puberty and Adolescence, The Sex Act, and Periods in the Life of Man.

It is encouraging, however, to find the available references in Human Reproduction increased by one more competent book.

EVELYN MORHOLT
Forest Hills High School
Long Island, New York

A Half Century of Teaching Science and Mathematics. Walter H. Carnahan, Editor. 197 pp. $2.50. Central Association of Science and Mathematics Teachers, Box 408, Oak Park, Illinois. 1950.

This volume, bound in gleaming gold and vivid red, is a worthy symbol of a notable anniversary recently celebrated by a strong, flourishing organization of teachers.

A most thoughtful preface points out the striking changes, both material and social, that have occurred in 50 years. Since 1900, millions have moved from the country into the city—a migration that continues. High school enrollment has increased tenfold, and the students are no longer selected as to bookish interests. Airplanes, radios, electric gadgets, farm tractors, motion pictures, penicillin, Einstein, World Wars were non-existent topics for science lessons as the century began. As these items and many others have originated and developed, science instruction has kept pace.

Five interests are pillars of the association's structure; each is presented as to its progress during five decades. These interests and their reporters are:

1. The Association and Its Journal—*School Science and Mathematics* (Edwin W. Schreiber, Glen W. Warner). As with any infant the first few years were precarious—but the "nurses" were devoted and resourceful.
2. Mathematics (Ernst R. Breslich). Largely a story of how mathematics moved down from the university into the high school. Adjustments toward a more functional study were made "as the school population increased and the interest of pupils declined."
3. Biological Sciences (Jerome C. Isenbarger, John C. Mayfield). How technical botany and zoology became applied biology, supporting the health of individuals and communities, the economics of agriculture, and the joy of having nature as a friend. Many investigations are concisely cited.
4. Physical Sciences (Ira C. Davis, Allen F. Meyer, Katharine U. Isenbarger, Milton O. Pella). Indicating the steps through which the purposes of instruction in these sciences changed from formal discipline to enriched living. Separate sections are given on physics, general science, physical ("integrated") science, chemistry, elementary school science, and geography. Many studies are cited.
5. The Preparation of Teachers (G. P. Cahoon, J. S. Richardson). Outlining the great advances from the days when "anyone could teach physics to high school students who had had a course in high school physics." The courses of certain pioneer science educators are described, and the influence of sundry important reports are explained concisely. The trends in today's training of science teachers are examined, and devices for extending experience, such as workshops, are noted as to origin and spread. "The preparation of teachers has been evolving slowly toward an experience curriculum."

Seven major emphases for future training of science and mathematics teachers are given—but should the alert members of our profession read these for themselves?

HANOR A. WEBB
George Peabody College for Teachers

How Big Is Big? Herman and Nina Schneider. Revised. 44 pp. $1.75. William R. Scott, Inc. New York. 1950.

A recent reprint in the Young Science Books series, *How Big Is Big?* will delight young readers eight to 11 years old and will help them to understand the sizes of things in their universe. They will consider things as large as the largest star and as small as the smallest sub-atomic particle. But they will be led gently to a size concept, with their own four-foot height as a point of reference. As they look at big things, they see first the familiar elephant, and next the trees and skycrapers. In the world of small things they notice first their own puppy, and then a mouse and a flea. But at the end of their journey the readers are assured that they are "just the right size . . . right in the middle, between an electron and a star."

The illustrations by Symeon Shimin give meaning as well as pleasure. A boy and girl can see, page by page, how their own size measures up in the worlds of big and small.

Books Received

An Introduction to the Anatomy of Seed Plants. Ernest L. Stover. 274 pp. $4.00. D. C. Heath and Company. Boston. 1951. A continuous story of seed plants from fertilized egg to woods and their identification.

An Outline of Scientific Criminology. Nigel Morland. 284 pp. Philosophical Library, Inc. New York. 1950. Discussion of problems, principles, techniques, and case studies.

Applied Nuclear Physics. Ernest Pollard and William L. Davidson. Second Edition. 352 pp. $5.00. John Wiley & Sons, Inc. New York. 1951. For researchers in the field of nuclear physics, a review and explanation of the science and its progress since 1942.

Borderlands of Science. Alfred Still. 424 pp. $3.75. Philosophical Library, Inc. New York. 1951. An attempt to evaluate the influence on civilization of both science and superstition . . . and "to consider those 'borderland' phenomena which the scientist rarely investigates notwithstanding that they occur in the natural world which he shares with the unreasoning multitude." Levitation, the subconscious mind, and the divining rod, for example, are considered.

Introductory Nuclear Physics. David Halliday. 558 pp. $6.50. John Wiley & Sons, Inc. New York. 1950. Rather advanced treatise dealing with philosophical aspects of nuclear physics, the assumptions underlying the theory, and the results predicted by the theory.

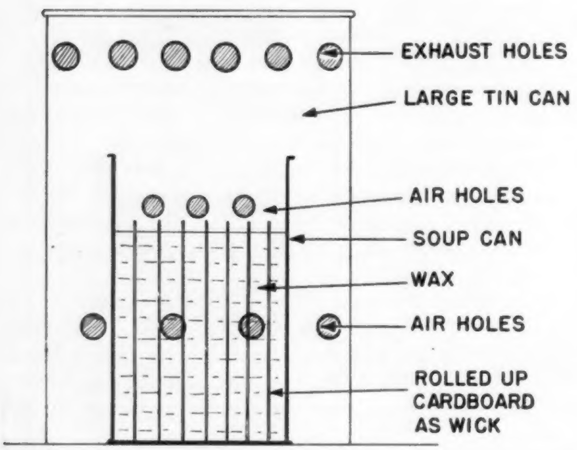
CLASSROOM ideas and demonstrations

Elementary Science

A Simple Stove or Hot Plate

By EVAN C. RICHARDSON, Science Instructor, State Teachers College, Newark, New Jersey.

The illustration suggests how to build an adaptation to take the place of gas heat or an alcohol burner. The gadget is called the "Buddy-burner." It is made by melting some paraffin wax in a clean, dry soup can until the can is two-thirds full, and then pressing a roll of cardboard of proper height into the melted wax, edge upward. This makes the burner, which works better if a few air holes are punched in the soup can just above the level of the wax. Now if a #10 tin can with two sets of air holes (punched as in the diagram) is inverted over the burner, we have a simple frame to serve as a small stove. In addition to its utility the Buddy-burner stove can serve as the focal point of a lesson on fuels and heating devices.



Physics

Two Demonstrations in Sound

By WALTER H. HELLMANN, Assistant Superintendent (Formerly Science Teacher), Fairfield Schools, Fairfield, Connecticut.

Here are two simple demonstrations which have been effective in illustrating important principles in sound. The first deals with overtones in a vibrating string. The materials required are a piece of ordinary string about 30 in. long, an electric doorbell, and a source of current for the bell. Fasten one end of the string to an upright on the demonstration table about a foot above the table top. Attach the other end of the string to the hammer of the doorbell from which the bell has been removed. Hold the bell so that the string is straight, without too much tension, and parallel with the table top. Attach the source of current to the bell terminals. As the hammer vibrates the string will also begin to vibrate, the nodes and loops being easily visible. By varying the tension on the string various numbers of overtones can be obtained—the tighter the string the fewer the overtones. With a little practice the demonstrator can obtain from two to six overtones.

The demonstration shows very clearly how a string can vibrate as a whole and in parts at the same time. Going on from here, the class may take a fundamental frequency, such as 256 v.p.s., and calculate the frequencies of the various overtones. It will be noted that the first (512, C′) and third (1024, C″) overtones bear octave relationships to the fundamental; also that the second (768, G′), and fourth (1280, E″), and fifth (1536, G″) are tones which form the major triad. Then

it is easily seen that these overtones reinforce the fundamental and give it body and richness. The dissonance between the sixth overtone (which has no counterpart in the middle-C octave) and the fundamental may be brought out through the problem which inquires why certain musical instruments suppress the sixth overtone. How about the seventh overtone—discord or harmony?

The second demonstration is designed to show the principle of interference or "beats." Place a piece of glass tubing, about 1½ in. in diameter and about 3 ft. long, over a lighted Bunsen burner. The flame of the burner is the usual blue one with about half volume from the gas cock. The result is the ordinary "singing flame" but with much greater volume than is ordinary with the narrow jet. Two burners set up in this fashion will produce sounds which may be regulated in frequency by simply turning the gas cock to varying positions. By adjusting one burner so that its frequency varies from that of the other, intense pulsations ("beats") will result. This demonstration of interference is much more striking than that of the tuning forks since the pulsations are very strong and may be continued as long as desired.

The principles of these two experiments may be extended, respectively, to harmonics and the heterodyne process in radio if desired.

Chemistry

Observations of an Old-Timer

By CHARLES H. STONE, Florida Sanitarium and Hospital, Orlando, Florida.

Teachers do too much telling. I have twice been in a position when visiting schools to overhear the work in the classroom. In both cases the teacher talked to the class for the entire hour. How much of that long tirade do you think the youngsters are going to retain? That is poor pedagogy.

Students are called upon to recite only on the matter in the texts. How often is a pupil called to the desk to solve some little problem experimentally? For example, I call Joe to the desk, and the conversation goes something as follows:

"Now, Joe, tell me about Priestley and his famous experiment."

"He discovered oxygen."

"How did he discover it?"

"He heated mercury oxide."

"Joe, I want you to repeat Priestley's experiment. Here is a tube with some of the oxide in it. Hold the tube as I show you. If you get oxygen, how will you know? Can you see it?"

"No sir."

"Then how will you know when oxygen comes?"

"Spark test."

In about two minutes or less Joe gets a good test.

"Thank you. Now, Walter, come here. You have seen the professor get mercury and oxygen by heating mercury oxide. Here is some copper oxide in this tube. You would expect to get copper and oxygen by heating this substance, would you not?"

"I guess so."

"Henry, you can try lead oxide while Walter tries copper oxide."

After several minutes of heating and testing in vain, Walter and Henry lay down their hot tubes.

"It won't work."

"Thank you, gentlemen. Now, Marion, what is the reason that the last two oxides do not decompose when heated in this manner?"

"I don't know."

"Just look at this list of metals. The inactive ones are at the bottom of the list, and the active ones are higher up. Where is mercury on the list?"

"It is very low on the list."

"Where are copper and lead?"

"They are higher up."

"Would you expect to get zinc and oxygen by heating zinc oxide?"

"I guess not."

"How about magnesium oxide?"

"I think that it wouldn't work."

"All right. Now, class, for the general statement. *Simple oxides of the metals do not decompose to yield oxygen when heated moderately.* Mercury oxide is an exception because mercury is an inactive metal and hence is very low in the list. Its hold on oxygen is easily broken by heating. What do you think about decomposing silver oxide?"

So you can go on with various other topics, telling the class as little as possible but making direct observation the source of learning. For example, prepare carbonates by the action of carbon dioxide on soluble hydroxides in solution; also, what is the action of nitric acid on carbonates? Do other acids act similarly? Will sulfuric acid dissolve barium carbonate? Why or why not? Try it. What happens when carbonates are heated? Try a number in separate hard-glass test tubes. Try decomposing lead carbonate, copper carbonate, and calcium carbonate. Then try barium carbonate.

The result? A live-wire class that learns—for the job of finding out for oneself teaches more than is taught in the textbook.

Summer Meeting Program

PLANS ARE MOVING forward for a three-week Institute on Science Teaching to be held in connection with the annual summer meeting of NSTA. Sponsored by the University of California in cooperation with the association, this special feature is scheduled for June 25–July 13 on the Berkeley campus. Registration for the Institute will be open to all science teachers in every section of the nation.

Part of the proposed session schedule includes an opportunity to work together on the preparation of instructional guides for various units in elementary and secondary school science courses. There is also the possibility of some part or full scholarships for the Institute from the university. Participants will move to Oakland, June 28–30, to attend the NSTA summer meeting on the Mills College campus. Attendance at this meeting is a planned part of the three-week Institute.

THIS JUNE there will be the opportunity you have been waiting for—the unbeatable combination for a teacher: that of making a trip to one of the Meccas of the West and at the same time attending a professional conference of value. Mills College, the site of the NSTA summer conference, is 35 minutes by car and easily reached by bus and train from San Francisco. It offers comfortable accommodations in a large residence hall at very reasonable rates ($5 per day for room and board).

A good program, with stimulating speakers, will challenge your thinking and give you opportunity to meet outstanding teachers in your field. The working study groups will have competent leaders and resource people so that the time spent in thinking through and discussing problems common to all should result in professional growth as well as enjoyment.

Some field trips are planned for the last day of the meeting, and they should be of particular interest to Easterners unfamiliar with the scenic locations in the San Francisco area. Come and share with others your teaching experiences, so that from all parts of the nation science teachers may gain insight, enthusiasm, and renewed vigor for their tasks.

Remember, too, that the 87th annual meeting of the NEA will follow in San Francisco (July 1–7). Travel may not be so easy another year. Take advantage of this opportunity for a thrilling vacation trip and a fine professional meeting.

ARCHIE MACLEAN
Conference Chairman

NSTA MEETING

The preliminary schedule for the summer meeting, announced in the February issue of *The Science Teacher,* is rapidly being completed. Topics for group discussion, built around the theme "Urgent Problems in Science Teaching," have now been selected and are listed below; conference keynote and general session speakers will be announced in April. Meals and dormitory accommodations on the campus will be provided for $5 per day. Conference registration will be $1 and will include the discussion group and conference reports.

TENTATIVE PROGRAM for the SUMMER CONFERENCE

Thursday, June 28—	Regional Conference on Industry-Science Teaching Relations
Evening, 7:30—	Registration; Social Gathering
Friday, June 29	
8:30	Registration (continued)
9:30	Opening Session; Keynote Speaker
10:30	Discussion Groups in Session

Group I	What are some good classroom techniques for teaching science, particularly in moving toward individualizing instruction in large classes?
Group II	What methods can science teachers use to help pupils develop skill in problem solving and critical thinking?

Group III	How can we find out the needs and interests of children and society, and how can we develop a functional science program in terms of these needs?	12:30	Luncheon—Special Interest (Tables arranged by interest groups—Elementary Science, Biology, General Science, etc.)
		2:00	Discussion Groups in Session
		4:00	Group Leaders and Recorders Meet
Group IV	How can traditional science content be adjusted to the newer trends in science education?	6:30	Dinner—Speaker
		Saturday, June 30—	
		9:00	General Session—Speaker
Group V	What is the role of the science teacher in the program of general education?	9:45	Discussion Groups in Session
		12:30	NSTA Luncheon
		2:30	Closing Session—Summaries and Resolutions; Conference Summary
Group VI	What are the responsibilities and opportunities for science teaching in the mobilization of education for national defense and in international relations?	Sunday, July 1—	Trips to Points of Interest
		Sunday & Monday, July 1, 2—	NSTA Board of Directors Meeting

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